



The Open
University

50
YEARS

A million questions per year: Hosting STACK at the Open University

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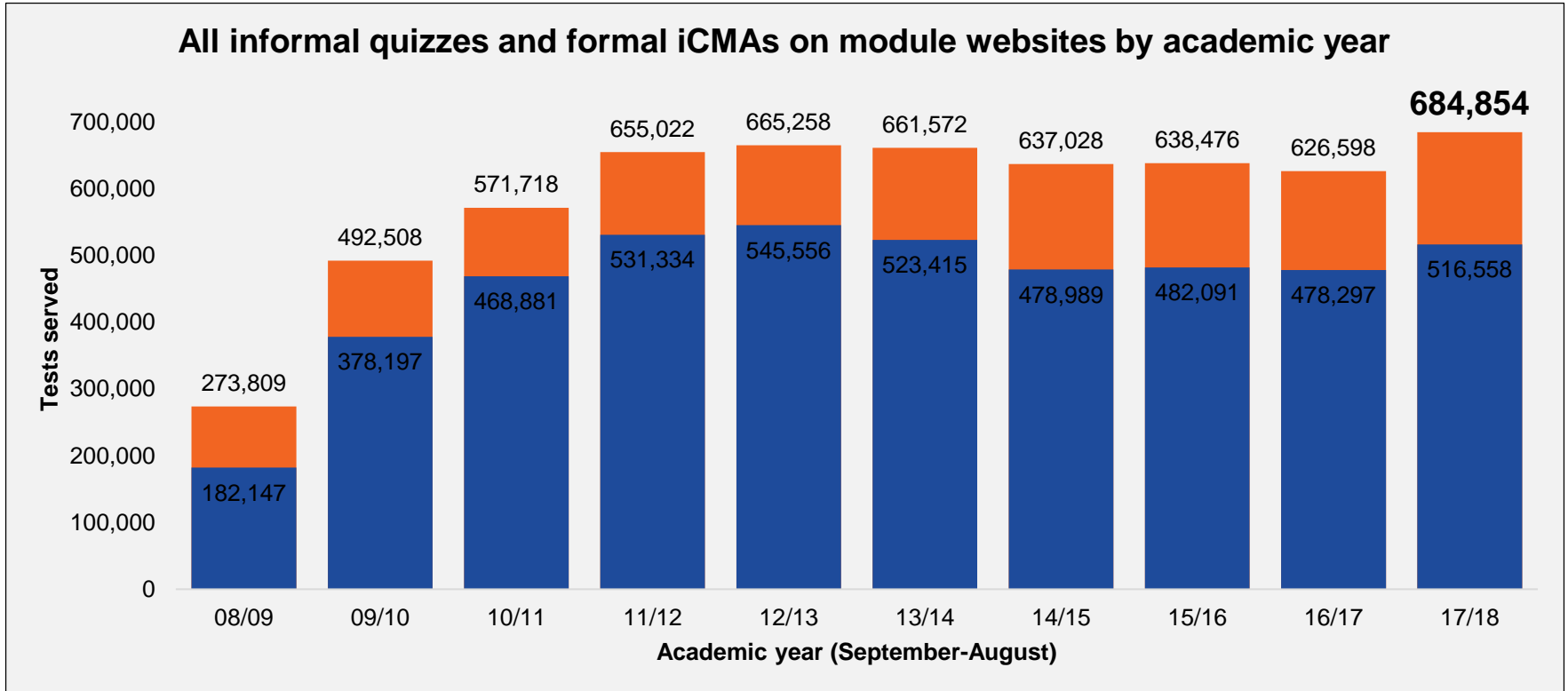
STACK is 'free' ...

... but it needs to be
properly cared for

Quiz at the OU

- **180,000** active users (students/staff)
- Around **450** module (courses) each year
- **40,000** logins per day
- **170,000** forum views per day
- **3,000** online tutorials per month (Adobe connect)
- **650,000** quiz attempts per year
- **6,700,000** questions attempted over last year

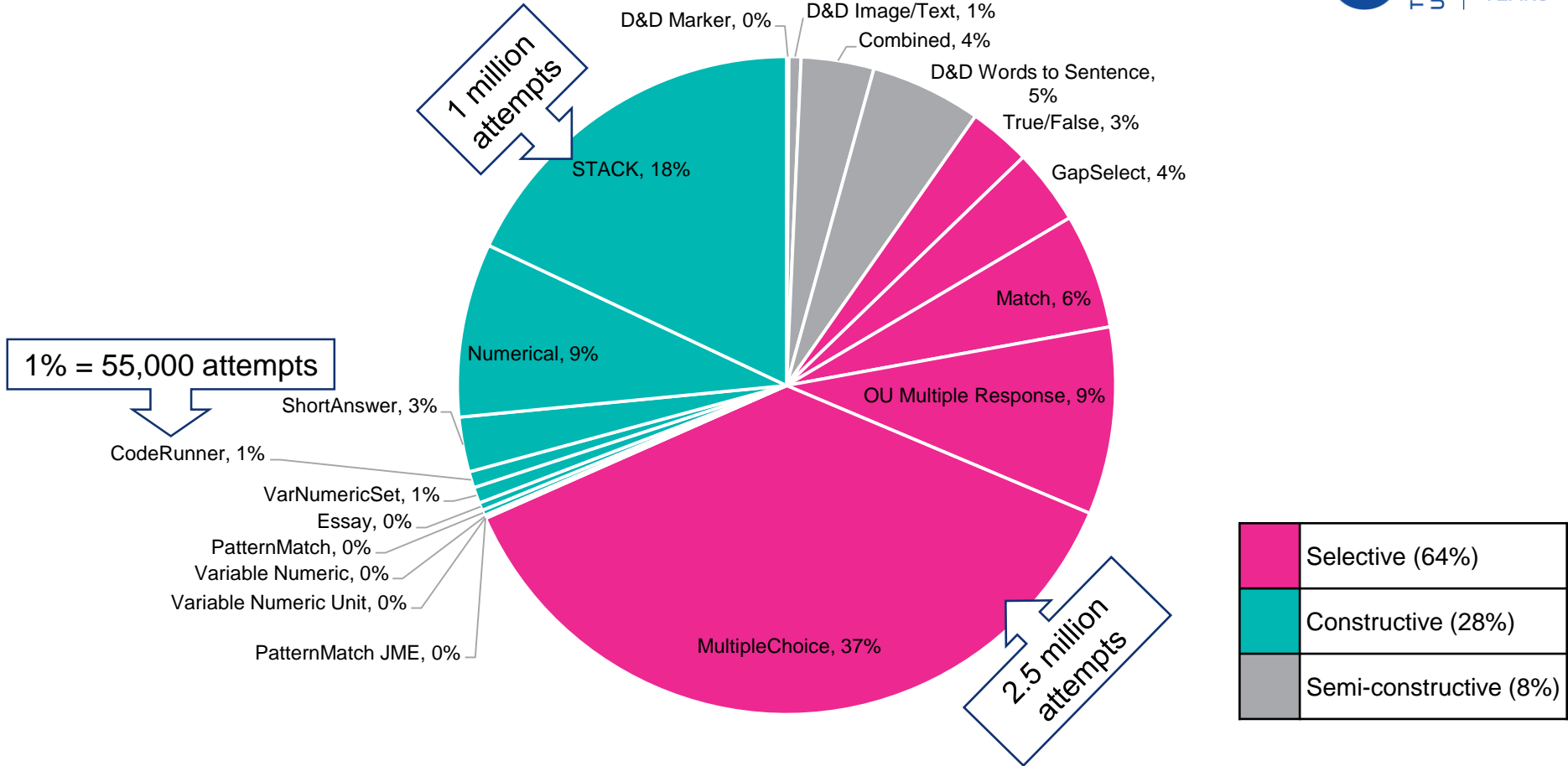
OU quiz usage over time



Orange: attempts started

Blue: attempt submitted

Question attempts / year



Hosting STACK

STACK is a question type (plus other plugins)
for Moodle

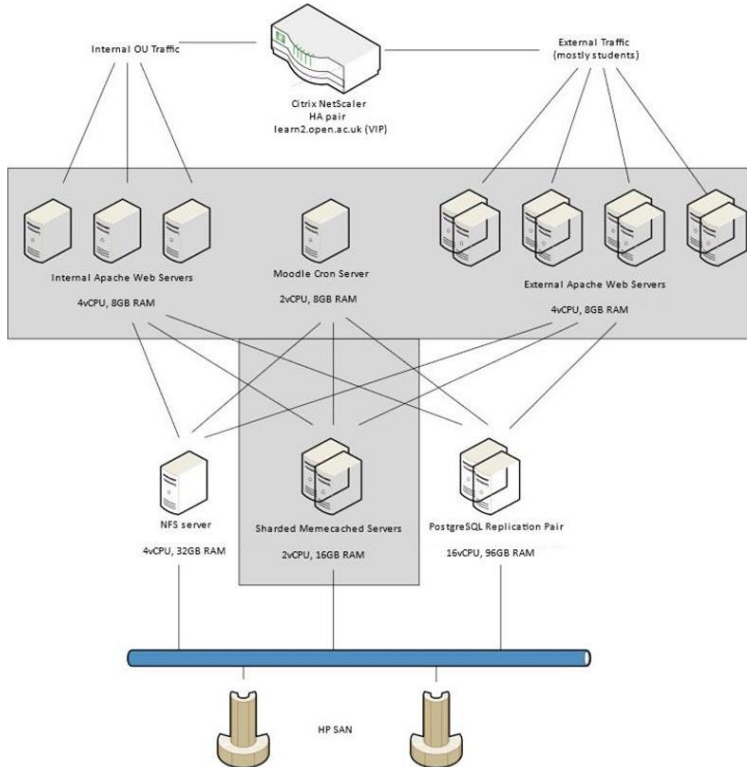
Installed in the usual way

Also requires Maxima (computer algebra package)
installed on the server

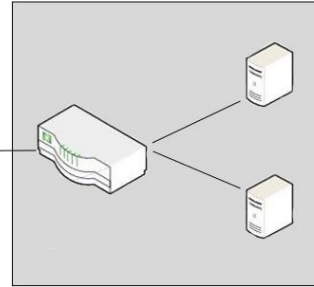
Well, installed on
a
server



Moodle



MaximaPool



```

/usr/bin/
gnuplot
maxima
# Installed as part of RHEL.
# maxima-optimised actually used, but this is present.

/usr/share/tomcat8/webapps/ or /var/lib/tomcat8/webapps/
MaximaPool.war
MaximaPool/
META-INF/
MANIFEST.MF
WEB-INF/
web.xml
classes/
servlet.conf # Configuration file: directory.root & admin.password.
... # All the compiled classes.

/usr/share/tomcat8/logs/ # The Tomcat logs.

/var/lib/maximapool/
pool.conf # This is the path directory.root from servlet.conf.
2013073001/ # Configuration for the whole pool.
process.conf # Directory name is a STACK Maxima code version number.
maxima-optimised # Configuration settings for this version.
maximalocal.mac # The pre-compiled Maxima executable.
maxima/ # Extra file loaded on start-up.
2013122500/ # Copy of question/type/stack/stack/maxima.
... # ... can be multiple versions present simultaneously.
    
```

https://github.com/maths/stack_util_maximapool/

Monitoring STACK

System performance

Name	Value
Servlet started:	2019-02-26 01:39:51
Up time:	59 days, 12 hours, 13 minutes, 3 seconds
Active threads:	76
Java free memory:	25.8 MB out of 89.9 MB total memory (512.0 MB max limit)
System load:	0.04 over 2 processors
System free memory:	613.9 MB out of 3.7 GB

Overall pool performance

Name	Value
Processes starting up:	0
Processes in use:	0
Total number of processes started:	914272

Running versions

Pool performance - 2018080600

Name	Value
Ready processes in the pool:	54
Total processes started:	768668
Current demand estimate:	107.85392264716667 Hz
Current start-up time estimate:	129 ms
Recent start-up times:	112 ms 116 ms 169 ms 132 ms 118 ms
Recent request times:	14:52:08 14:52:08 14:52:12 14:52:30 14:52:32

[Run the high-level health-check](#)

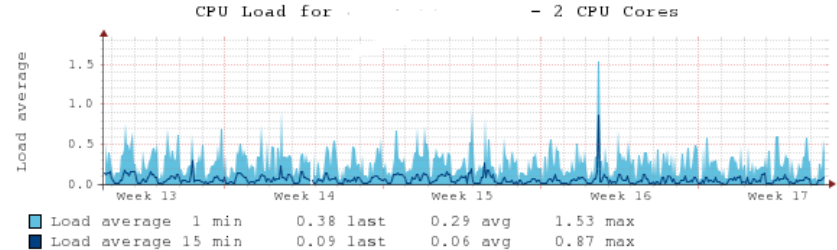
[Run the low-level health-check](#)

Password

Host: Service: CPU load

One Month 25.03.19 13:50 - 26.04.19 13:50

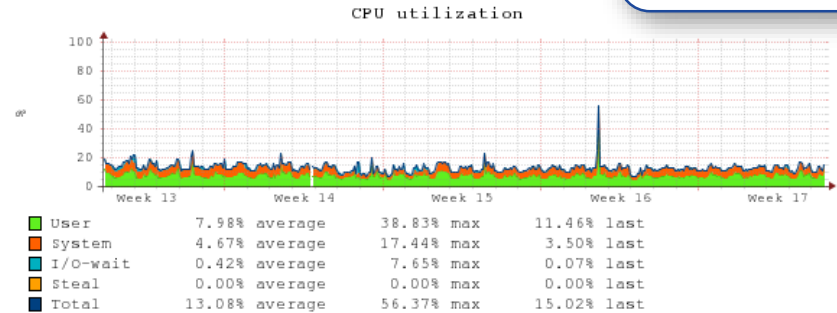
Datasource: load1



Host: Service: CPU utilization

One Month 25.03.19 13:50 - 26.04.19 13:50

Datasource: CPU utilization



Nagios triggers alerts for IT Ops if values go out of allowed range

Upgrading STACK

Standard Moodle plugins

- Upgraded as usual

STACK-Maxima library code

- Build maxima-optimised
- Deploy to MaximaPool

```
/var/lib/maximapool/  
pool.conf  
  
2018080600/  
  process.conf  
  maxima-optimised  
  maximalocal.mac  
  maxima/  
  
2019042600/  
  process.conf  
  maxima-optimised  
  maximalocal.mac  
  maxima/  
  
...
```

This is the path directory.root from servlet.conf.
Configuration for the whole pool.

Directory name is a STACK Maxima code version number.
Configuration settings for this version.
The pre-compiled Maxima executable.
Extra file loaded on start-up.
Copy of question/type/stack/stack/maxima.

Configuration settings for this version.
The pre-compiled Maxima executable.
Extra file loaded on start-up.
Copy of question/type/stack/stack/maxima.

To help deployment MaximaPool
can run multiple pools

Deploy new maxima code
Test with test Moodle install
Upgrade live Moodle
Un-deploy old maxima code

Testing STACK

Lots of tools

1. Healthcheck page
2. Automated tests (PHPUnit & Behat)
3. Answer-tests and Input-tests scripts
4. Question tests

Trying to connect to the CAS 1

We are trying to evaluate the following CAS test:

The derivative of $(x^4/(1+x^4))$ is $(\frac{d}{dx}(\frac{x^4}{1+x^4})) = (\frac{d}{dx}(\frac{x^4}{1+x^4}))$

The derivative of $\frac{x^4}{1+x^4}$ is

$$\frac{d}{dx} \frac{x^4}{1+x^4} = \frac{4x^3}{x^4+1} - \frac{4x^2}{(x^4+1)^2}$$

Maxima version

Correct and expected STACK-Maxima library version being used (2018080600).

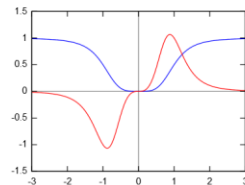
Graph plotting

There should be two different plots. If two identical plots are seen then this is an error in naming the plot files. If no errors are returned, but a plot is not displayed then one of the following may help: (i) check read permissions on the two temporary directories. (ii) change the options used by GNUPlot to create the plot. Currently there is no web interface to these options.

Two example plots below. `{(plot((x^4/(1+x^4)),diff(x^4/(1+x^4)),x,-3,3))} {(plot((t*(x^2-x^2),x,-3,3))} {(plot((t*(x^2-x^2),x,-3,3),gr14249)} A third, sma`

`x`

Two example plots below:



Correct and expected STACK-Maxima library version being used (2018080600).

Useful links

- [Documentation for STACK](#): a local static wiki.
- The [healthcheck script](#) helps you verify that all aspects of STACK are working properly 1
- The [CAS chat script](#) lets you test the connection to the CAS, and try out Maxima syntax.
- The [answer-tests script](#) verifies that the answer tests are performing correctly. They are also useful to learn by example how each answer-test can be used. 3
- The [input-tests script](#) provides test cases of how STACK interprets mathematical expressions. They are also useful to learn by example.
- The [run the question tests in bulk script](#) lets you easily run all the STACK questions in a given context. Not only does this test the questions. It is also a good way to re-populate the CAS cache after it has been cleared. 4
- The [fix maths delimiters script](#) can be used to replace old-style delimiters like `@...@`, `$....$` and `$$...$$` in your questions with the new recommended `{@...@}`, `(...)` and `[...]`.

A test suite for validation of student's input 3

This page allows you to test how STACK interprets various inputs from a student. This currently only checks with the most liberal settings, trying to adopt an informal syntax and insert stars. * columns record validity as judged by PHP and the CAS. V1 = PHP valid, V2 = CAS valid.

Passed?	Student response	V1	PHP output	Answer note	PHP errors	V2	CAS value	CAS display	CAS errors
Whitespace									
Pass	x		php_true	x			cas_true	x	x
This is a single variable name, not a product.									
Pass	xy		php_true	xy			cas_true	xy	xy (0+xy)
Pass	x+1		php_true	x+1			cas_true	x+1	x+1
Pass	x+ 1		php_true	x+ 1			cas_true	x+1	x+1
Ok to have some spaces between these operators.									
Pass	x + 1		php_true	x + 1			cas_true	x+1	x+1

Number of tests: 330

Tests took 25.66276 seconds.

Average per test: 0.07761 seconds.

CAS results are being cached in the database.

All tests passed!

Question tests save lives

Do all questions work with the latest version of STACK?

4

Contexts with STACK questions

- ...
- iCMA: Experimental practice quiz 1 (2)
- Website: MST124-18J (317)
- iCMA: ICMA 41 (10)
- iCMA: ICMA 42 (19)
- iCMA: ICMA 43 (18)
- iCMA: ICMA 44 (30)
- Website: MST125-18J (188)
- iCMA: ICMA 41 (10)
- iCMA: ICMA 42 (15)
- iCMA: ICMA 43 (10)
- iCMA: ICMA 44 (13)
- Website: MST224-18J (30)
- Website: MU123-18J (127)
- Website: T192-18J (31)
- iCMA: ICMA 54 (2)
- iCMA: Revision quiz 54 (2)
- Website: M248-18J (43)
- Website: T194-18J (248)
- iCMA: ICMA 51 (11)
- iCMA: ICMA 52 (10)
- iCMA: ICMA 53 (10)
- iCMA: ICMA 54 (10)
- iCMA: ICMA 55 (10)
- iCMA: ICME 81 (10)
- ...

Run all the question tests for all the questions in the system (slow, admin only)

Running all the question tests in iCMA: iCMA 54

Default for iCMA 54 (1)

Q06 (1)

This category contains 1 STACK questions.

01.17.B: Solve linear equation (requires expanding) (copy)

Seed 245536861

* 3 passes and 0 failures.

Seed 1712272007

* 3 passes and 0 failures.

Seed 62373792

* 3 passes and 0 failures.

Seed 632174873

* 3 passes and 0 failures.

Seed 742562383

* 3 passes and 0 failures.

Q16 (1)

This category contains 1 STACK questions.

02.03.B: Gradient, intercepts from line (implicit)

Seed 2008104642

* 4 passes and 0 failures.

Seed 1924756826

* 4 passes and 0 failures.

Seed 345183888

* 4 passes and 0 failures.

Seed 535896912

* 4 passes and 0 failures.

Seed 783258838

* 4 passes and 0 failures.

Overall result

All tests passed!

Advertising feature: Ad-hoc database queries

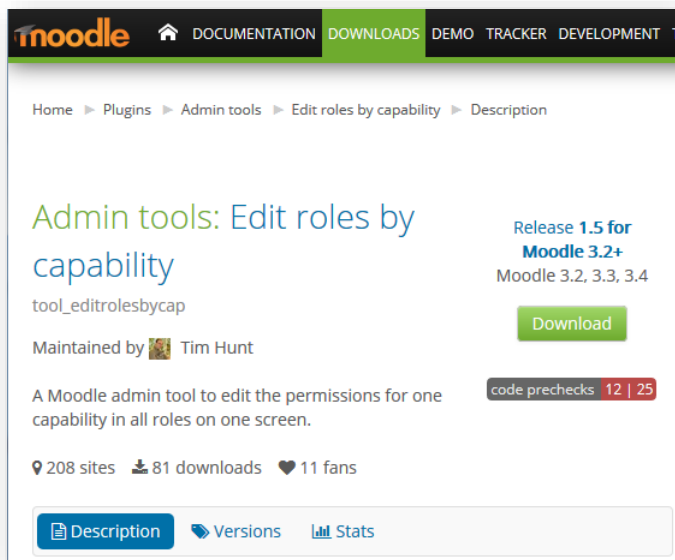
A useful tool for admins

Often a STACK upgrade issue affects several questions

STACK - log10

This reports finds STACK questions that might suffer from the 'log10' issue.

Website	Question category	Question	Edit	Question bank	Preview	Question tests
EMQB-WS	Tim Revise and Refresh OSEP testing	1. Doublings	Edit	Q bank	Preview	Tests
MATHS-WS-OSEP	03.09-1 Exponential growth/decay applications	03.09-1A Exponential Growth/Decay	Edit	Q bank	Preview	Tests
MST124-17J	03.09-1 Exponential growth/decay applications	03.09-1A Exponential Growth/Decay	Edit	Q bank	Preview	Tests
MST124-18B	03.09-1 Exponential growth/decay applications	03.09-1A Exponential Growth/Decay	Edit	Q bank	Preview	Tests
MST124-18J	03.09-1 Exponential growth/decay applications	03.09-1A Exponential Growth/Decay	Edit	Q bank	Preview	Tests
MST124-19B	03.09-1 Exponential growth/decay applications	03.09-1A Exponential Growth/Decay	Edit	Q bank	Preview	Tests
MU123-16J	13.11.01.RepeatedDouble	13.11.01. STACK: Doublings	Edit	Q bank	Preview	Tests
MU123-17B	13.11.01.RepeatedDouble	13.11.01. STACK: Doublings	Edit	Q bank	Preview	Tests



The screenshot shows the Moodle Admin Tools interface for 'Edit roles by capability'. The page title is 'Admin tools: Edit roles by capability' with the tool ID 'tool_editrolesbycap'. It is maintained by Tim Hunt and is available for Moodle 3.2, 3.3, and 3.4. A 'Download' button is present, and a badge indicates 'code prechecks 12 | 25'. The page also shows statistics: 208 sites, 81 downloads, and 11 fans. Navigation tabs for 'Description', 'Versions', and 'Stats' are visible at the bottom.

It's not all bad

```
SELECT COUNT(1)
FROM {question_attempts} qa
JOIN {question} q ON q.id = qa.questionid
JOIN {quiz_attempts} quiza
    ON quiza.uniqueid = qa.questionusageid
WHERE quiza.preview = 0
AND q.qtype = 'stack'
AND qa.timemodified BETWEEN
    %%STARTTIME%% AND %%ENDTIME%%
```

STACK: question attempts per week

Number of times students have attempted STACK questions in the preceeding week.

query run date	count
2018-12-01	26988
2018-12-08	36473
2018-12-15	41070
2018-12-22	15669
2018-12-29	9639
2019-01-05	15005
2019-01-12	21553
2019-01-19	32031
2019-01-26	23976
2019-02-02	26042
2019-02-09	34234
2019-02-16	37884
2019-02-23	44110
2019-03-02	45438
2019-03-09	28816
2019-03-16	25830
2019-03-23	31175
2019-03-30	35896
2019-04-06	33864
2019-04-13	47676
2019-04-20	29061

Supporting STACK

STACK: used by people

Powerful systems are complex

⇒ People need training

- Like Tim Lowe's training that you are missing now!

⇒ People need documentation

⇒ Worth sharing good practice

STACK is an essential part of teaching learning & assessment

⇒ Users need to know about upgrades


⇒ Upgrades must to avoid key dates



Announcements and self-support forum for the STACK qtype.

(Main guidance on STACK.)

Start a new discussion

Discussion	Unread	Last post ▾	Posts	Started by
 Introductions		18/10/18, 09:27 Jon Hall	18	 Chris Nelson Moderator
Plot labels		9/04/19, 16:20 Grahame Erskine	1	 Grahame Erskine
FYI: No changes in STACK in the March VLE release		23/01/19, 17:42 Tim Hunt	1	 Tim Hunt
Numerical display		17/01/19, 21:26 Grahame Erskine	5	 Grahame Erskine
STACK 4.2 message		21/12/18, 13:24 Tim Hunt	2	 Grahame Erskine

Advertising feature: Embedded questions

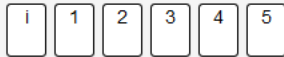
Having got STACK, make the most of it

The familiar

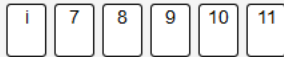
QUIZ NAVIGATION



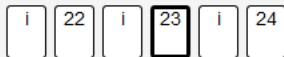
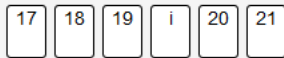
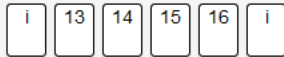
QUESTION BEHAVIOURS



NAVIGATION



QUESTIONS



REPORTS



GRADEBOOK



Finish attempt ...

Start a new preview

Question 23

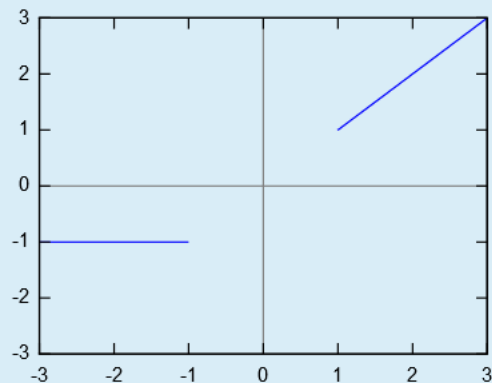
Tries remaining: 2

Marked out of 4.00

Flag question

Edit question

Can you find a function which smoothly bridges the gap between these two straight lines:



$$f(x) = \frac{(x+1)^2}{4} + \frac{(x+1)^3}{8} - 1$$

Your last answer was interpreted as follows:

$$\frac{(x+1)^2}{4} + \frac{(x+1)^3}{8} - 1$$

Your answer is partially correct!

Here is what your answer looks like:

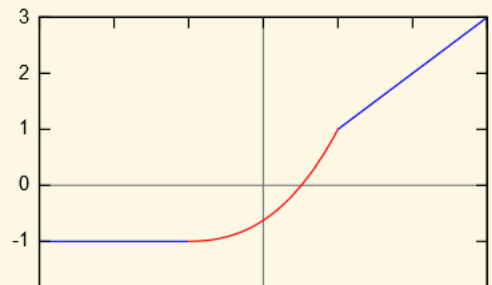


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- 1. Introduction
- 2. Deriving spline curves
 - 2.1. A first example**
 - 2.2. Setting up splines systematically
 - 2.3. Bases
- 3. Some uses of splines

ADMINISTRATION



Splines are fun

2. Deriving spline curves

2.1. A first example

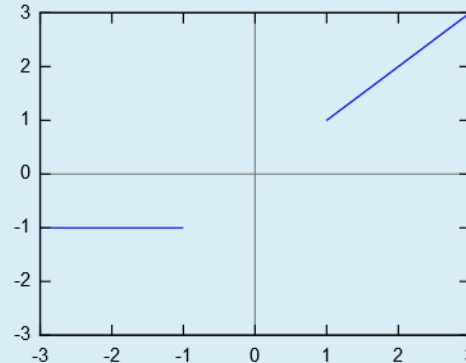
Before we look at the systematic technique for computing spline curves, Try calculating one by hand in the following example:

Question

Tries remaining: 2

Marked out of 4.00

Can you find a function which smoothly bridges the gap between these two straight lines:



$f(x) =$

Your last answer was interpreted as follows:

$x + 1$

Check



This is a Moodle Book resource

How to set up

Splines are fun

Editing chapter

Previous chapter

...iving spline curves

Chapter title *

A first example

Subchapter

Content *



A rich text editor toolbar with various icons for text formatting, alignment, and media insertion. A blue circle highlights the list icon (three horizontal lines).

Before we look at the systematic technique for computing spline curves, Try calculating one by hand in the following example:

{Q{STACK/smooth|c3439e5c7873336996ddd7c5cacce86d9eba9b601cd0db524cb7abd220daabf8}Q}

Embed question



▶ Expand all

▼ Which question

Question category *

Example STACK questions [ID:STACK] (1) ▼

Question *

Smoothly connect the lines [ID:smooth] ▼

▶ Attempt options

▶ Display options

Embed question

Filters: Embed questions

filter_embedquestion

Maintained by Tim Hunt, John Beedell, Mahmoud Kassaei

A Moodle text filter plugin that displays questions from the question bank embedded in the page.

📍 119 sites 📄 159 downloads ❤️ 17 fans [Add to my favourites](#)

Atto: Embed question

atto_embedquestion

Maintained by Tim Hunt, John Beedell, Mahmoud Kassaei

An Atto editor plugin for use with the embed questions filter.

📍 87 sites 📄 95 downloads ❤️ 7 fans [Add to my favourites](#)

Summary



Summary

Servers

Software

Monitoring

Upgrades

Testing

Support

People

Non-STACK Plugins advertised

https://moodle.org/plugins/report_customsql

https://moodle.org/plugins/filter_embedquestion

https://moodle.org/plugins/atto_embedquestion

THANK YOU!

✉ T.J.Hunt@open.ac.uk

🐦 [@tim_hunt](https://twitter.com/tim_hunt)



50
YEARS