

# WeBWork: Open Source On-line Homework for Mathematics

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# Outline

- A brief and incomplete history of web homework systems, 1992–present.
- Some similarities and differences between current systems.
- Capabilities and characteristics of WeBWork and (some) other systems.
- WeBWork demonstration, including student and instructor views.
- Some details of WeBWork
  - Features,
  - Philosophy, and
  - Neat and Technical Stuff.
- Conclusions, such as they are.



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# normal_prob(a, b, mean=0, deviation=1),
m = random(2,4,1);
sp = random(0.2, 0.5, 0.1);
$ans1 = Compute[ $p ];
lex = $a*$p;
$ans1rule = $ans1->ans_rule();

# first set up some probabilities that work
$ans2 = Compute[ 0 ];
$ans2rule = $ans1->ans_rule();
@pvals = {};
push @pvals, Compute[ "1 - 2*$p" ];
for ( my $i=1; $i<$n; $i++ ) {
  push @pvals, Compute[ "2*$p*(n-$i)" ];
}
push @pvals ;

# then we can set up the multianser for the probabilities
$op = MultiAnswer( @pvals )->with(
  singleResult=>0,
  checker=>sub {
    my ( $c, $s, $ansHash ) = @_;
    my $c = $c;
    my $s = $s;
    my $pr = $pr;

    my $prprob = 0;
    my $seval = 0;
    for ( my $i=0; $i=<=$s; $i++ ) {
      $prprob += $s[$i];
      $seval += $i*$s[$i];
    }
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# normal_prob(a, b, mean=0, deviation=1);
m = random(2,4);
ip = random(0.2, 0.5, 8.1);
$ans1 = Compute[ $p ];
lex = $m*ip;
$ans1rule = $ans1->ans_rule();

# first set up some probabilities that work
$ans2 = Compute[ 4 ];
$ans2rule = $ans2->ans_rule();
@pvals = {};
push @pvals, Compute[ "1 - 2*$p" ];
for ( my $i=1; $i<$n; $i++ ) {
  push @pvals, Compute[ "2*$p*(n-$i)" ];
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    my $c = $c;
    my $s = $s;
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    my $eval = 0;
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# The Past Decade

- **2009** : The AMS undertook a survey of US mathematics departments to assess use of and experiences with on-line homework (contacted 1230 departments; responses from 467, including 57 statistics departments).
  - **About half** of doctoral mathematics departments were using on-line homework.
  - MyMathLab had the largest overall user base (110 departments, 230,000 students annually).
  - WebAssign (80 users, 100,000 students) and WeBWork (55 users, 100,000 students) were the next most popular.



*n.b.: the survey predated Cengage's acquisition of WebAssign.*

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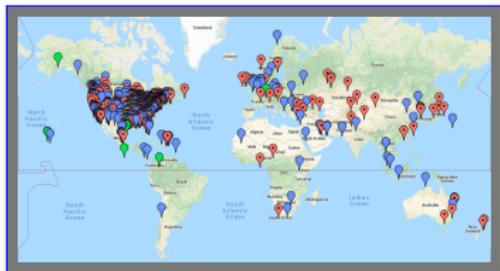
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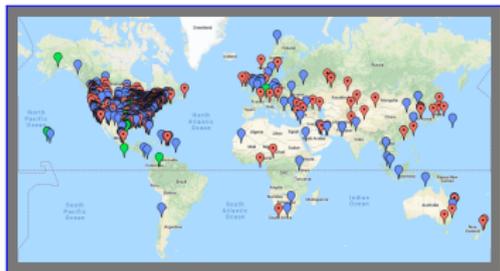
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  - **WileyPlus** (Wiley); **ALEKS** (McGraw Hill). . .
- Independent systems have a smaller user base
  - WeBWork (*over 1,300 institutions*)
  - Maple T.A., rebranded Möbius (spun off to DigitalEd)
  - . . . and IMathAS (“Internet Mathematics Assessment System”), which powers MyOpenMath and LumenOHM, Ximera (Ohio State—an “interactive textbook platform”), local systems (Kansas State,. . .), . . .
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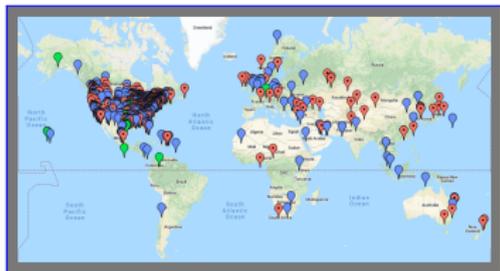
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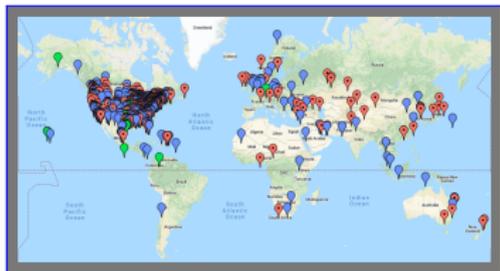
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# System Comparisons

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Stu. license	Inst. license	Inst. support	Ext. support
<i>MyMathLab, WebAssign, . . . , Möbius (\$29/s) LumenOHM (\$25/s)</i>	<i>Möbius, LumenOHM WebAssign?</i>	<i>WeBWork, IMathAS</i>	<i>Ximera, MyOpenMath, "WeBWork"</i>

- Hosting Model

Cloud	Local
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- LMS Interoperability

Advanced	Basic	None
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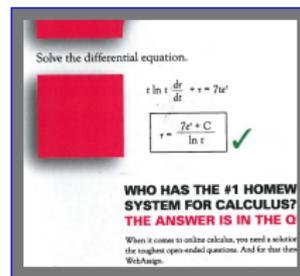
# Common Capabilities/Features

- Similarities between WeBWork and Publisher Systems

- Robust and varied answer checking.
  - *CAS integration vs. programmatic and MathObjects answer checking, Sage...*

- Significant problem libraries.  
(WeBWork's OPL currently has 35,000 problems)
  - *Some direct textbook problem tagging.*

- LTI Support (that is, connections to any modern LMS).



MATH 216 FA 2018

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Members

This course site serves to distribute files to you, and for you to submit some assignments to your instructors. For most course information you should consult the [main.course.web@uic.edu](mailto:main.course.web@uic.edu) which lists in Canvas

What's with the picture here? It's a graph of the solution to a system of differential equations modeling a ruby laser. The model looks at the number of atoms in the laser in an excited state,  $N$ , and the intensity of the light emitted,  $P$ , as functions of time. The graph here shows what happens to the intensity when the energy pumped into the system (to make the laser emit light) has a small oscillatory component. We look at this model in lab 3, and will see how to solve systems modeling this type of

Graph of  $P(t)$  with  $A(t)$

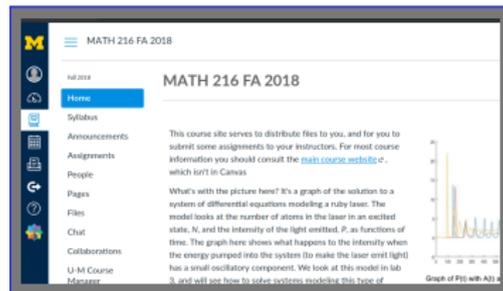
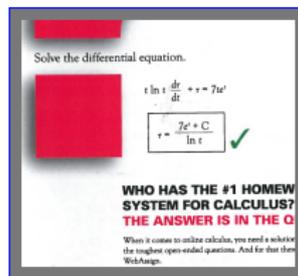
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- Similarities between WeBWork and Publisher Systems

- Robust and varied answer checking.
  - *CAS integration vs. programmatic and MathObjects answer checking, Sage...*

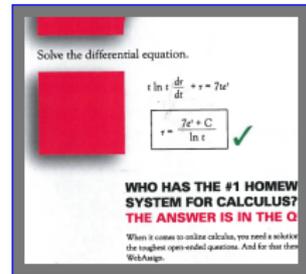
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(WeBWork's OPL currently has 35,000 problems)
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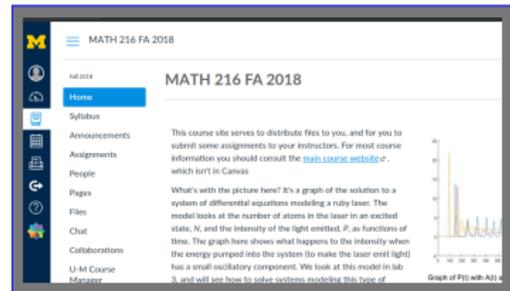


Solve the differential equation.

$$t \ln t \frac{dr}{dt} + r = 7r^2$$
$$r = \frac{7r^2 + C}{\ln t}$$

WHO HAS THE #1 HOMEWORK SYSTEM FOR CALCULUS? THE ANSWER IS IN THE O

When it comes to online calculus, you need a website the toughest open-ended questions. And for that there's WeBWork.



MATH 216 FA 2018

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U-M Course

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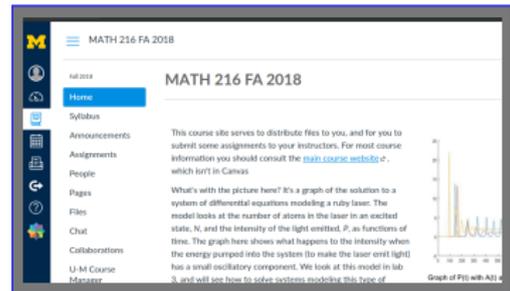
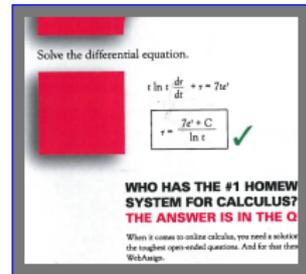
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# Differences in Capabilities/Features

- Differences between WeBWork and Publisher Systems

- **Incomplete text problems**

- *But: textbook problems tend to be similar...*

- No links back to textbooks

- No “plug and play.”

- *But: LMS Interoperability*



- Other Thoughts

- SSO support exists in WeBWork, and maybe other systems.

- Features generally exceed *used* features.

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- Student view
  - Setup
  - Homework assignments
  - (Gateway) Tests
  - Settings & Grades
- Administrator view
  - Web interface—Add/edit courses, manage locations.
- Instructor view
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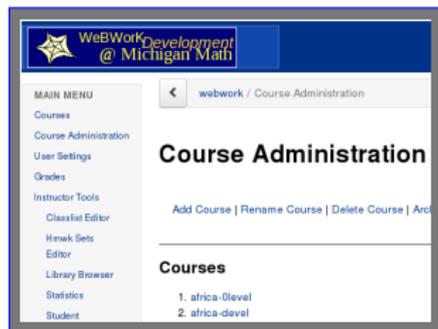
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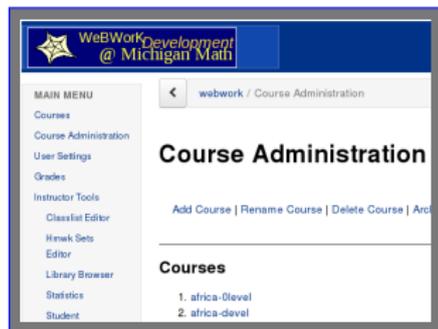
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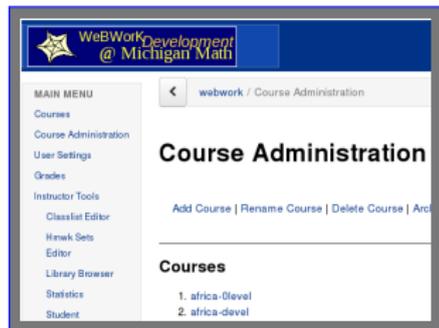
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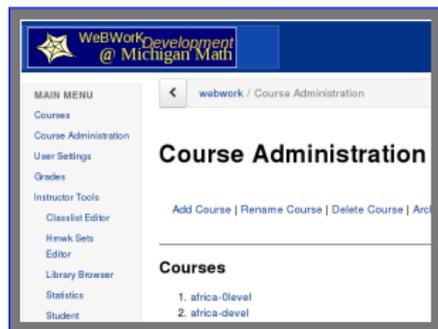
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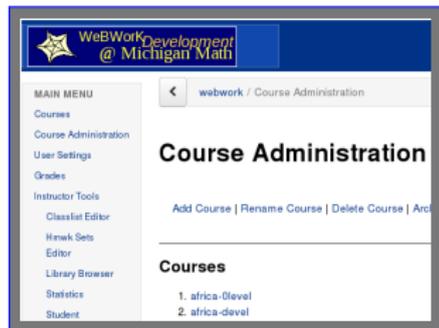
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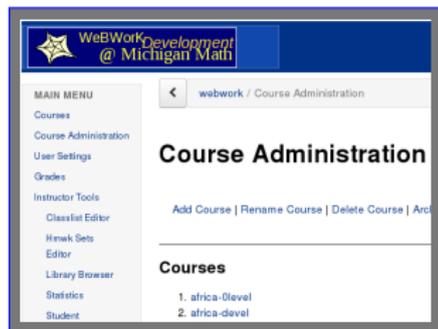
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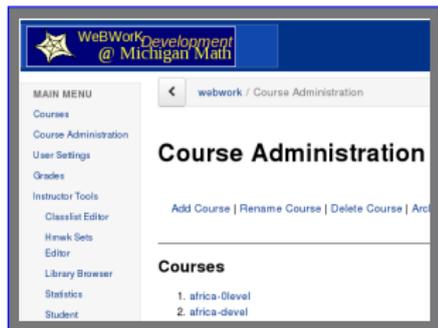
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User:Chassisplans

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The screenshot shows the homepage of the Mathematics Instructional Technology department at the University of Michigan. The header features the department's name in a stylized font with a globe icon. Below the header is a welcome message and a navigation bar. The main content is divided into two columns: 'Students' Info' and 'Instructors' Info'. The 'Students' Info' column lists various resources for students, including links to student data forms, proctored gateways, and specific course resources for various math courses. The 'Instructors' Info' column lists resources for instructors, including training materials, course support, and course repository uploaders. The 'Other Resources' section at the bottom provides links to instructional labs and information about the math department.

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**Beginning of term**

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**Class resources**

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The screenshot shows the homepage of the Mathematics Instructional Technology department at the University of Michigan. The header features the department's name and logo. Below the header is a welcome message and a navigation bar. The main content is divided into two columns: 'Students' Info' and 'Instructors' Info'. The 'Students' Info' column lists various resources for students, including links to student data forms, proctored gateways, and specific course resources for Math 105, 115, 116, 214, 216, 217, 295, and 412. The 'Instructors' Info' column lists resources for instructors, including training materials, course support, and course repository uploaders. The 'Other Resources' section at the bottom provides a link to the Instructional Labs information page.

**Mathematics** the University of Michigan

**Instructional Technology**

Welcome to the Instructional Technology home of the Department of Mathematics at the University of Michigan. E-mail the Math Instructional Technology Consultant, [math-icc@umich.edu](mailto:math-icc@umich.edu). See also the Department's [math technology page](#).

### Students' Info

**Beginning of term**

- Student data form: [form](#) | [FAQ](#)

**Class resources**

- Proctored Gateways:
- **Ma105:** [WebHW](#); [Gateway](#); [ExamScores](#); [MidtermEval](#)
- **Ma115:** [WebHW](#); [Gateway](#); [ExamScores](#); [MidtermEval](#)
- **Ma116:** [WebHW](#); [Gateway](#); [ExamScores](#); [MidtermEval](#)
- **Ma214:** [WebHW](#); [Ex/HWData](#); [\[course site\]](#)
- **Ma216:** [WebHW](#); [Gateway](#); [Ex/HWData](#); [Demos](#)
- **Ma216:** [WebHW](#); [Ex/HWData](#); [Demos](#); [Peracasts](#)
- **Ma217:** [WebHW](#); [Gateway](#); [Ex/HWData](#)
- **Ma295:** [WebHW](#) (Joy of Sets, Math Hygiene sets)
- **Ma412:** [WebHW](#)
- **Ma425:** [WebHW](#); Sections [001 & 006](#); [005 & 009](#)

**Other Resources**

- [Instructional Labs](#) Information about the math

### Instructors' Info

**Beginning of term**

- Training Materials [tutorial](#)
- Instructional Tech [resource overview](#)
- Course Support & Course Repository: [uploader](#); [Canvas](#): [canvas.tut](#)
- Student data form

**Class resources**

- **Ma105:** [WebHW](#); [G](#)
- **Ma115:** [WebHW](#); [G](#)
- **Ma116:** [WebHW](#); [G](#)
- **Ma214:** [WebHW](#); [G](#)
- **Ma215:** [WebHW](#); [G](#)
- **Ma216:** [WebHW](#); [G](#)
- **Ma217:** [WebHW](#); [G](#)
- **Ma295:** [WebHW](#); [G](#)

# Underpinnings and Implications

- Because data are in a database, or files:
  - It is possible to automate administrative tasks.
  - It is possible to provide additional service or student/instructor interaction.

```
root@paws F1012 ~ # ./webwork/bin/sunresults -s -s
sunresults version 2.52 (last mod. 26 Sep 2017)
results suscriber for WeBWorK gateway tests
-----
Course(s) to summarize letter s.e., j > 116
Exam(s) to consider for 116
0. PracticeEntrQW
1. PracticeEntrQW
2. PracticeIntegralQW
3. PracticeIntegralQW
(N,M or [crl] for all) > 1
File(s) for output [crl] for /tmp/116res.txt > ./116res_180920.txt
Current term (s, j, i) > 06, 07, 08, 09 [F10] >

Connecting to database... done
Reading results data... done
Writing output... done
Starting mail routine
reading = mail lists... done
building data list... done
ready to mail results: [crl] to mail:
001 002 003 004 005 009 010 011 012 013 014 015
019 020 021 022 023 024 025 026 028 030 031 033
034 035 036 039 040 041 042 043 044 045 048 050
052 055 057 060 065 069 170 171 done
root@paws F1012 ~ #
```

```
root@paws gateway12/webwork/bin/woed
webwork ver 1.77 (last mod 31 Jul 2018)
* update script for WeBWorK gateway/hostname courses *
* added courses will be for term F10 *

Main Menu:
Select: 1. list defined courses
2. delete and archive course(s) from list of defined courses
3. add course(s) to system
4. create assignments in course
5. add proctors to courses
6. delete global proctors from courses
7. delete course proctors from courses
8. update rosters from course CSV files
9. update rosters for all courses in a term from course CSV files
10. list archived courses
0. quit

selection > 9

* update rosters for all courses in a term *
* term to update [result] > F10
* course extension [crl] for none >
* updating by course number: 105
* reading data for course rosters...
105-001 105-002 105-003 105-004 105-011 105-012 105-013 105-014 105-015 105-016
14 105-018 105-019 105-020 105-021 105-022 105-024 105-025 105-026 105-027 105-028 105-029 105-030
105-061 105-062 105-063 105-064 105-065 105-066 105-067 105-068 105-069 105-070
105-171 105-172 105-173 105-174 105-175 105-176 105-177 105-178 105-179 105-180 done
77 105-179 105-180 done
* reading roster data from webwork courses
* reading roster data from webwork courses
105-001 105-002 105-003 105-004 105-011 105-012 105-014 105-015 105-016
11 105-022 105-024 105-025 105-031 105-033 105-035 105-044 105-045 105-046 105-047
052 105-055 105-057 105-061 105-063 105-065 105-066 105-067 105-068 105-069 105-070
177 105-179 105-180 done
* doing updates
105-001 105-002 105-003 105-004 105-011 105-012 105-014 105-015 105-016
11 105-022 105-024 105-025 105-031 105-033 105-035 105-044 105-045 105-046 105-047
052 105-055 105-057 105-061 105-063 105-065 105-066 105-067 105-068 105-069 105-070
177 105-179 105-180 done
* dropped students:
105-065: [removed] [crl] [crl] [crl]
105-170: [removed] [crl] [crl]
* saved students:
105-012-105-178: [removed] [crl] [crl]
105-025-105-014: [removed] [crl] [crl]
* done
* updating by course number: 115
* reading data for course rosters...
115-001 115-002 115-003 115-004 115-005 115-006 115-007 115-008 115-009 115-010 115-011 115-012 115-013 115-014
07 115-008 115-009 115-010 115-011 115-012 115-022 115-023 115-024 115-025
115-026 115-027 115-028 115-029 115-030 115-031 115-032 115-033 115-034 115-035 115-036 115-037 115-038 115-041 115-042
31 115-032 115-033 115-036 115-037 115-038 115-041 115-042 115-043 115-044 115-045 115-046 115-047 115-048
115-049 115-050 115-051 115-052 115-053 115-054 115-055 115-056
59 115-058 115-061 115-062 115-063 115-064 115-065 115-066 115-067 115-068 115-069 115-070
115-061 115-062 115-063 115-064 115-065 115-066 115-067 115-068 115-069 115-070
08 115-071 115-072 115-073 115-074 115-075 115-076 115-077 115-078 115-079 115-080 115-081
115-082 115-083 115-084 115-085 115-086 115-087 115-088 115-089 115-090 115-091
115-092 115-093 115-094 115-095 115-096 115-097 115-098 115-099 115-100 115-101
115-102 115-110 115-111 115-112 115-113 115-114 115-115 115-116 115-117 115-118 115-119 115-120 115-121
2 115-130 115-170 115-171 115-172 115-173 115-174 115-175 115-176 115-177 115-178 done
* reading roster data from webwork courses...
115-001 115-002 115-003 115-004 115-005 115-006 115-007 115-008 115-009 115-010 115-011 115-012 115-013 115-014 115-015 115-016 115-017 115-018 115-019 115-020 115-021 115-022 115-023 115-024 115-025 115-026 115-027 115-028 115-029 115-030 115-031
```

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sunresults version 2.52 (last mod. 26 Sep 2017)
results suscriber for WebWork gateway tests
-----
Course(s) to summarize letter s.e., j > 116
Exam(s) to consider for 116
0. PracticeEntr0M
1. PracticeEntr0M
2. PracticeIntegral0M
3. PracticeIntegral0M
(In M or [cr] for all) > 1
File(s) for output [cr] for /tmp/116res.txt > ./116res_180920.txt
Current term (e.g., 106_w07_s08_u09) [F10] >

Connecting to database... done
Reading results data... done
Writing output... done
Starting mail routine
reading = mail lists... done
building data list... done
ready to mail results: [cr] to mail:
001 002 003 004 005 009 010 011 012 013 014 015
019 020 021 022 023 024 025 026 028 030 031 033
034 035 036 039 040 041 042 043 044 045 048 050
052 055 057 060 065 069 170 171 done
root@pass F1012:
```

```
root@pass gateway12/webwork/bin/woed
webWork ver 1.77 (last mod 31 Jul 2018)
* update script for WebWork gateway/hoework courses *
* added courses will be for term F10 *

Main Menu:
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        8. update rosters from course CSV files
        9. update rosters for all courses in a term from course CSV files
        10. list archived courses
        0. quit

selection: 9

* update rosters for all courses in a term *
* term to update [result] > F10
* course extension [cr] for none >
* updating by course number: 105
* reading data for course rosters...
105-001 105-002 105-003 105-004 105-011 105-012 105-013 105-014 105-015 105-016
14 105-018 105-019 105-020 105-021 105-022 105-024 105-025 105-026 105-027 105-028 105-029 105-030
105-031 105-032 105-033 105-034 105-040 105-041 105-042 105-043 105-044 105-045 105-046 105-047
105-171 105-172 105-173 105-174 105-175 105-176 105-177 105-178 105-179 105-180 done
77 105-179 105-180 done
* reading roster data from webwork courses
105-001 105-002 105-003 105-004 105-011 105-012 105-014 105-015 105-016
11 105-022 105-024 105-025 105-031 105-033 105-035 105-044 105-045 105-046 105-047
105-052 105-053 105-054 105-055 105-056 105-057 105-058 105-059 105-060 105-061 105-062 105-063 105-064
177 105-179 105-180 done
* doing updates
105-001 105-002 105-003 105-004 105-011 105-012 105-014 105-015 105-016
11 105-022 105-024 105-025 105-031 105-033 105-035 105-044 105-045 105-046 105-047
105-052 105-053 105-054 105-055 105-056 105-057 105-058 105-059 105-060 105-061 105-062 105-063 105-064
177 105-179 105-180 done
* dropped students:
105-160 105-161 105-162 105-163 105-164 105-165 105-166 105-167 105-168 105-169 105-170 105-171 105-172 105-173 105-174 105-175 105-176 105-177 105-178 105-179 105-180
* saved students:
105-012-105-178 105-013 105-014 105-015 105-016 105-017 105-018 105-019 105-020 105-021 105-022 105-023 105-024 105-025 105-026 105-027 105-028 105-029 105-030 105-031 105-032 105-033 105-034 105-035 105-036 105-037 105-038 105-039 105-040 105-041 105-042 105-043 105-044 105-045 105-046 105-047 105-048 105-049 105-050 105-051 105-052 105-053 105-054 105-055 105-056 105-057 105-058 105-059 105-060 105-061 105-062 105-063 105-064 105-065 105-066 105-067 105-068 105-069 105-070 105-071 105-072 105-073 105-074 105-075 105-076 105-077 105-078 105-079 105-080 105-081 105-082 105-083 105-084 105-085 105-086 105-087 105-088 105-089 105-090 105-091 105-092 105-093 105-094 105-095 105-096 105-097 105-098 105-099 105-100 105-101 105-102 105-103 105-104 105-105 105-106 105-107 105-108 105-109 105-110 105-111 105-112 105-113 105-114 105-115 105-116 105-117 105-118 105-119 105-120 105-121 105-122 105-123 105-124 105-125 105-126 105-127 105-128 105-129 105-130 105-131 105-132 105-133 105-134 105-135 105-136 105-137 105-138 105-139 105-140 105-141 105-142 105-143 105-144 105-145 105-146 105-147 105-148 105-149 105-150 105-151 105-152 105-153 105-154 105-155 105-156 105-157 105-158 105-159 105-160 105-161 105-162 105-163 105-164 105-165 105-166 105-167 105-168 105-169 105-170 105-171 105-172 105-173 105-174 105-175 105-176 105-177 105-178 105-179 105-180 105-181 105-182 105-183 105-184 105-185 105-186 105-187 105-188 105-189 105-190 105-191 105-192 105-193 105-194 105-195 105-196 105-197 105-198 105-199 105-200 105-201 105-202 105-203 105-204 105-205 105-206 105-207 105-208 105-209 105-210 105-211 105-212 105-213 105-214 105-215 105-216 105-217 105-218 105-219 105-220 105-221 105-222 105-223 105-224 105-225 105-226 105-227 105-228 105-229 105-230 105-231 105-232 105-233 105-234 105-235 105-236 105-237 105-238 105-239 105-240 105-241 105-242 105-243 105-244 105-245 105-246 105-247 105-248 105-249 105-250 105-251 105-252 105-253 105-254 105-255 105-256 105-257 105-258 105-259 105-260 105-261 105-262 105-263 105-264 105-265 105-266 105-267 105-268 105-269 105-270 105-271 105-272 105-273 105-274 105-275 105-276 105-277 105-278 105-279 105-280 105-281 105-282 105-283 105-284 105-285 105-286 105-287 105-288 105-289 105-290 105-291 105-292 105-293 105-294 105-295 105-296 105-297 105-298 105-299 105-300 105-301 105-302 105-303 105-304 105-305 105-306 105-307 105-308 105-309 105-310 105-311 105-312 105-313 105-314 105-315 105-316 105-317 105-318 105-319 105-320 105-321 105-322 105-323 105-324 105-325 105-326 105-327 105-328 105-329 105-330 105-331 105-332 105-333 105-334 105-335 105-336 105-337 105-338 105-339 105-340 105-341 105-342 105-343 105-344 105-345 105-346 105-347 105-348 105-349 105-350 105-351 105-352 105-353 105-354 105-355 105-356 105-357 105-358 105-359 105-360 105-361 105-362 105-363 105-364 105-365 105-366 105-367 105-368 105-369 105-370 105-371 105-372 105-373 105-374 105-375 105-376 105-377 105-378 105-379 105-380 105-381 105-382 105-383 105-384 105-385 105-386 105-387 105-388 105-389 105-390 105-391 105-392 105-393 105-394 105-395 105-396 105-397 105-398 105-399 105-400 105-401 105-402 105-403 105-404 105-405 105-406 105-407 105-408 105-409 105-410 105-411 105-412 105-413 105-414 105-415 105-416 105-417 105-418 105-419 105-420 105-421 105-422 105-423 105-424 105-425 105-426 105-427 105-428 105-429 105-430 105-431 105-432 105-433 105-434 105-435 105-436 105-437 105-438 105-439 105-440 105-441 105-442 105-443 105-444 105-445 105-446 105-447 105-448 105-449 105-450 105-451 105-452 105-453 105-454 105-455 105-456 105-457 105-458 105-459 105-460 105-461 105-462 105-463 105-464 105-465 105-466 105-467 105-468 105-469 105-470 105-471 105-472 105-473 105-474 105-475 105-476 105-477 105-478 105-479 105-480 105-481 105-482 105-483 105-484 105-485 105-486 105-487 105-488 105-489 105-490 105-491 105-492 105-493 105-494 105-495 105-496 105-497 105-498 105-499 105-500 105-501 105-502 105-503 105-504 105-505 105-506 105-507 105-508 105-509 105-510 105-511 105-512 105-513 105-514 105-515 105-516 105-517 105-518 105-519 105-520 105-521 105-522 105-523 105-524 105-525 105-526 105-527 105-528 105-529 105-530 105-531 105-532 105-533 105-534 105-535 105-536 105-537 105-538 105-539 105-540 105-541 105-542 105-543 105-544 105-545 105-546 105-547 105-548 105-549 105-550 105-551 105-552 105-553 105-554 105-555 105-556 105-557 105-558 105-559 105-560 105-561 105-562 105-563 105-564 105-565 105-566 105-567 105-568 105-569 105-570 105-571 105-572 105-573 105-574 105-575 105-576 105-577 105-578 105-579 105-580 105-581 105-582 105-583 105-584 105-585 105-586 105-587 105-588 105-589 105-590 105-591 105-592 105-593 105-594 105-595 105-596 105-597 105-598 105-599 105-600 105-601 105-602 105-603 105-604 105-605 105-606 105-607 105-608 105-609 105-610 105-611 105-612 105-613 105-614 105-615 105-616 105-617 105-618 105-619 105-620 105-621 105-622 105-623 105-624 105-625 105-626 105-627 105-628 105-629 105-630 105-631 105-632 105-633 105-634 105-635 105-636 105-637 105-638 105-639 105-640 105-641 105-642 105-643 105-644 105-645 105-646 105-647 105-648 105-649 105-650 105-651 105-652 105-653 105-654 105-655 105-656 105-657 105-658 105-659 105-660 105-661 105-662 105-663 105-664 105-665 105-666 105-667 105-668 105-669 105-670 105-671 105-672 105-673 105-674 105-675 105-676 105-677 105-678 105-679 105-680 105-681 105-682 105-683 105-684 105-685 105-686 105-687 105-688 105-689 105-690 105-691 105-692 105-693 105-694 105-695 105-696 105-697 105-698 105-699 105-700 105-701 105-702 105-703 105-704 105-705 105-706 105-707 105-708 105-709 105-710 105-711 105-712 105-713 105-714 105-715 105-716 105-717 105-718 105-719 105-720 105-721 105-722 105-723 105-724 105-725 105-726 105-727 105-728 105-729 105-730 105-731 105-732 105-733 105-734 105-735 105-736 105-737 105-738 105-739 105-740 105-741 105-742 105-743 105-744 105-745 105-746 105-747 105-748 105-749 105-750 105-751 105-752 105-753 105-754 105-755 105-756 105-757 105-758 105-759 105-760 105-761 105-762 105-763 105-764 105-765 105-766 105-767 105-768 105-769 105-770 105-771 105-772 105-773 105-774 105-775 105-776 105-777 105-778 105-779 105-780 105-781 105-782 105-783 105-784 105-785 105-786 105-787 105-788 105-789 105-790 105-791 105-792 105-793 105-794 105-795 105-796 105-797 105-798 105-799 105-800 105-801 105-802 105-803 105-804 105-805 105-806 105-807 105-808 105-809 105-810 105-811 105-812 105-813 105-814 105-815 105-816 105-817 105-818 105-819 105-820 105-821 105-822 105-823 105-824 105-825 105-826 105-827 105-828 105-829 105-830 105-831 105-832 105-833 105-834 105-835 105-836 105-837 105-838 105-839 105-840 105-841 105-842 105-843 105-844 105-845 105-846 105-847 105-848 105-849 105-850 105-851 105-852 105-853 105-854 105-855 105-856 105-857 105-858 105-859 105-860 105-861 105-862 105-863 105-864 105-865 105-866 105-867 105-868 105-869 105-870 105-871 105-872 105-873 105-874 105-875 105-876 105-877 105-878 105-879 105-880 105-881 105-882 105-883 105-884 105-885 105-886 105-887 105-888 105-889 105-890 105-891 105-892 105-893 105-894 105-895 105-896 105-897 105-898 105-899 105-900 105-901 105-902 105-903 105-904 105-905 105-906 105-907 105-908 105-909 105-910 105-911 105-912 105-913 105-914 105-915 105-916 105-917 105-918 105-919 105-920 105-921 105-922 105-923 105-924 105-925 105-926 105-927 105-928 105-929 105-930 105-931 105-932 105-933 105-934 105-935 105-936 105-937 105-938 105-939 105-940 105-941 105-942 105-943 105-944 105-945 105-946 105-947 105-948 105-949 105-950 105-951 105-952 105-953 105-954 105-955 105-956 105-957 105-958 105-959 105-960 105-961 105-962 105-963 105-964 105-965 105-966 105-967 105-968 105-969 105-970 105-971 105-972 105-973 105-974 105-975 105-976 105-977 105-978 105-979 105-980 105-981 105-982 105-983 105-984 105-985 105-986 105-987 105-988 105-989 105-990 105-991 105-992 105-993 105-994 105-995 105-996 105-997 105-998 105-999 106-000 106-001 106-002 106-003 106-004 106-005 106-006 106-007 106-008 106-009 106-010 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106-136 106-137 106-138 106-139 106-140 106-141 106-142 106-143 106-144 106-145 106-146 106-147 106-148 106-149 106-150 106-151 106-152 106-153 106-154 106-155 106-156 106-157 106-158 106-159 106-160 106-161 106-162 106-163 106-164 106-165 106-166 106-167 106-168 106-169 106-170 106-171 106-172 106-173 106-174 106-175 106-176 106-177 106-178 106-179 106-180 106-181 106-182 106-183 106-184 106-185 106-186 106-187 106-188 106-189 106-190 106-191 106-192 106-193 106-194 106-195 106-196 106-197 106-198 106-199 106-200 106-201 106-202 106-203 106-204 106-205 106-206 106-207 106-208 106-209 106-210 106-211 106-212 106-213 106-214 106-215 106-216 106-217 106-218 106-219 106-220 106-221 106-222 106-223 106-224 106-225 106-226 106-227 106-228 106-229 106-230 106-231 106-232 106-233 106-234 106-235 106-236 106-237 106-238 106-239 106-240 106-241 106-242 106-243 106-244 106-245 106-246 106-247 106-248 106-249 106-250 106-251 106-252 106-253 106-254 106-255 106-256 106-257 106-258 106-259 106-260 106-261 106-262 106-263 106-264 106-265 106-266 106-267 106-268 106-269 106-270 106-271 106-272 106-273 106-274 106-275 106-276 106-277 106-278 106-279 106-280 106-281 106-282 106-283 106-284 106-285 106-286 106-287 106-288 106-289 106-290 106-291 106-292 106-293 106-294 106-295 106-296 106-297 106-298 106-299 106-300 106-301 106-302 106-303 106-304 106-305 106-306 106-307 106-308 106-309 
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052 055 057 060 065 069 170 171 done
root@pass F1012 ~ #
```

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webWork ver 1.77 (last mod 21 Jul 2018)
* update script for WebWork gateway/hostname courses *
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6. delete global proctors from courses
7. delete course proctors from courses
8. update rosters from course CSV files
9. update rosters for all courses in a term from course CSV files
10. list archived courses
0. quit

selection > 9

* update rosters for all courses in a term *
* term to update [result] > F10
* course extension [cr] for none >
* updating by course number: 105
* reading data for course rosters...
105-001 105-002 105-003 105-004 105-011 105-012 105-013 105-014 105-015 105-016
14 105-018 105-019 105-020 105-021 105-022 105-024 105-025 105-026 105-027 105-028 105-029 105-030
105-031 105-032 105-033 105-034 105-040 105-041 105-042 105-043 105-044 105-045 105-046 105-047
105-171 105-172 105-173 105-174 105-175 105-176 105-177 105-178 105-179 105-180 done
77 105-179 105-180 done
* reading roster data from webwork courses
105-001 105-002 105-003 105-004 105-011 105-012 105-013 105-014 105-015 105-016
11 105-022 105-024 105-025 105-031 105-033 105-035 105-044 105-045 105-046 105-047
05 105-050 105-051 105-052 105-053 105-054 105-055 105-056 105-057 105-058 105-059 105-060 105-061
177 105-179 105-180 done
* doing updates
105-001 105-002 105-003 105-004 105-011 105-012 105-013 105-014 105-015 105-016
11 105-022 105-024 105-025 105-031 105-033 105-035 105-044 105-045 105-046 105-047
05 105-050 105-051 105-052 105-053 105-054 105-055 105-056 105-057 105-058 105-059 105-060 105-061
177 105-179 105-180 done
* dropped students:
105-160 105-161 105-162 105-163 105-164 105-165 105-166 105-167 105-168 105-169 105-170
105-171 105-172 105-173 105-174 105-175 105-176 105-177 105-178 105-179 105-180
* saved students:
105-012-105-178 105-013-105-179 105-014-105-180 105-015-105-181 105-016-105-182
105-025-105-014 105-026-105-014 105-027-105-014 105-028-105-014 105-029-105-014
* done
* updating by course number: 115
* reading data for course rosters...
115-001 115-002 115-003 115-004 115-005 115-006 115-007 115-008 115-009 115-010 115-011 115-012
07 115-008 115-009 115-010 115-011 115-012 115-013 115-014 115-015 115-016 115-017 115-018 115-019
115-020 115-021 115-022 115-023 115-024 115-025 115-026 115-027 115-028 115-029 115-030 115-031
115-032 115-033 115-034 115-035 115-036 115-037 115-038 115-039 115-040 115-041 115-042
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59 115-056 115-061 115-062 115-063 115-064 115-065 115-066 115-067 115-068 115-069 115-070
115-071 115-072 115-073 115-074 115-075 115-076 115-077 115-078 115-079 115-080 115-081 115-082
08 115-083 115-084 115-085 115-086 115-087 115-088 115-089 115-090 115-091 115-092 115-093
115-094 115-095 115-096 115-097 115-098 115-099 115-100 115-101 115-102 115-103 115-104 115-105
2 115-106 115-107 115-108 115-109 115-110 115-112 115-113 115-114 115-115 115-116 115-117 115-118
115-119 115-120 115-121 115-122 115-123 115-124 115-125 115-126 115-127 115-128 115-129 115-130 115-131
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09 115-010 115-011 115-012 115-013 115-014 115-015 115-016 115-017 115-018 115-019 115-020 115-021
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# The Philosophy of WeBWork

- Why WeBWork?

*think:  $\LaTeX$*

- What should it do?

- *Let you do what you want.*

Implication: Not necessarily to make it easy to code problems.

But: one thing we want to do is write problems in  $\LaTeX$ .

```
## EditionText1('7')
## AuthorText1('Hughes-Hallett')
## Section1('8.2')
## Problem1('1')

DOCUMENT();
loadMacros("PGstandard.pl", "MathObjects.pl", "PGML.pl",
           "parserPopUp.pl");
[]
Context("Numeric");
$m = random(2,4,1); $x0 = random(1,3,1); $b = $m*$x0;

TEXT(beginproblem());
BEGIN_PGML
The region bounded by the line [ $y = {b} - {m} x$ ] between [ $x = 0$ ]
and [ $x = {x0}$ ] is revolved around the [ $x$ ]-axis. To find the volume
of this solid of revolution, we would evaluate the integral

$$\int_0^{x0} \pi(b - mx)^2 dx$$

END_PGML

# give a solution (available after the due date)
# BEGIN_PGML_SOLUTION
#_
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# Neat Tricks

- Note: WeBWork problems are small Perl programs.
  - Thus: **it's possible to check any answer** for which one can write an algorithmic test.
  - But *it's better than that!* They are Perl programs with added macros that allow mathematical operations:
    - ```
$f = Formula('sin(x^2 + 3)');  
$f_deriv = $f->D();  
$stanline = $f->eval(x=>$x0) +  
    $f_deriv->eval(x=>$x0)*(x - $x0);
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    - ```
$v2 = Compute("<-3,1>");  
ANS( $v2->cmp( checker=>sub {  
    my ($correct, $student, $ansHash) = @_  
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}, showCoordinateHints => 0 ) );
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  - Needed: a server; WeBWork installs with git, from github, and requires  $\text{\LaTeX}$ , Perl, apache, MySQL (or MariaDB);
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  - Which usually works perfectly fine...  
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  - Documentation is pretty good, though it needs freshening.
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# Conclusions

- WeBWork vs. Publisher Systems

- Both can provide good homework sets
- and can be (relatively) easy to use.
- Both have costs to use.



- We pick a system based on our situation

- University policy.
- Available resources (monetary, staff).
- Philosophy and interest.



- WeBWork is open source, robust, powerful, and has an active developer community.

- *it's been around for 20-odd years, and there's a concerted effort to ensure it will continue.*

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