

# **2005-2007 LITRE Grant Proposal**

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## **1. Project Title:**

Creation of Interactive Maple Practice Sessions and QuickTime Video Versions of Maple Lessons

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## **2. Project Coordinator:**

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## **3. Other Participants:**

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## **4. College or Unit:**

PAMS

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## **5. Department:**

Mathematics

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## **6. Project Description:**

Over the last 5 years I have overseen the development of software tools that serve as the backbone of the Maple component of the curriculum in the Engineering Calculus sequence MA 141, MA 241 and MA 242. The software tools are used to (1) create homework problems sets with randomized data, (2) store and then distribute the problem sets to students via dynamic web pages, (3) provide instant grading of the problem sets using the internet, and (4) keep track of grades for download by faculty members. For the grading of the homework worksheets eGrader uses "grading code" written in the Maple programming language. The grading code is quite flexible and allows for partial credit assignments. However, in order to make meaningful partial credit assignments on a specific problem one needs to know what mistakes students tend to make in working that problem. The major goal of this project is to use the Archived Maple homework from the last two years to discover in detail the mistakes students make on calculus problems written in Maple worksheet format, and to use that data to rewrite the partial credit assignments in all of the MA141, 241 and 242 homework assignments. Once the grading code in the problem sets is updated, other software will be used to create "interactive Maple practice sessions" for students that will allow them to quickly learn the right way to solve problems in Maple. The software to create the interactive sessions has already been created - what is needed now is "meaningful partial credit assignments" so that when a student makes a (known) mistake in an

interactive session, eGrader can instantly supply the student with a comment that will point the student in the right direction. I hope to create somewhat of an expert system that continually learns the mistakes that calculus students tend to make when working calculus problems in Maple worksheets.

The plan of the project is as follows:

I. For 2005-2006: Hire a student (undergrad or grad) to:

(a) slightly modify the grading code of the existing archived problems to allow extraction of "new mistakes" from the archived problems sets submitted during the 2003-2004 and 2004-2005 academic years. The software to collect the new mistakes is already available.

(b) write simple software routines to manipulate the extracted data (i.e. categorize mistakes, discard duplicates, etc).

II. For 2006-2007:

(a) Hire a student (undergrad or grad) to use the data collected in I to write new partial credit assignments in all of the Maple problem sets for MA 141, 241 and 242.

(b) Once the grading codes for the problems are updated, L.K. Norris will use existing software to create interactive Maple practice sessions for students. These interactive sessions will complement the existing Maple Basics Lessons. Thus the updated grading code will serve two purposes: (1) to supply comments on mistakes (in Maple worksheet format) to students once the deadline for the homework has passed, and (2) to provide instant comments to students on mistakes made during the interactive practice sessions. It is envisioned that a student will turn to the interactive sessions for help after trying to work a problem without success.

(c) L.K. Norris will create QuickTime video versions of the Maple lessons for MA 241 and MA 242. In Summer 2004 Norris created, as part of NCSU DELTA grant, QuickTime video versions of the Maple lessons for MA 141.

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## 7. Project Objectives:

The pedagogical goal of this project is to enhance the learning of Maple by the roughly 3000 students who enroll in MA 141, MA 241 and MA 242 each semester. During the last year the Department of Mathematics has moved away from formal instruction in Maple labs as attendance at the labs dropped off dramatically during the latter part of each semester. To replace the formal labs we have substituted online learning tools for self study by the students. In particular all of the MA 141 Maple Lessons are presented in three formats: (1) a Maple worksheet version of the lesson, (2) an html version of the exported worksheet for viewing in a browser, and (3) 5-7 short QuickTime videos per lesson that explain the details of the lessons to the student. I want to continue the effort and create QuickTime video versions of the Maple lessons for MA 241 and MA 242.

Despite having these learning tools available some students still need extra help as evidenced by the low scores some students receive on their Maple homework. Including QuickTime video versions of the Maple lessons for MA 241 and MA 242 should enhance the learning of Maple by students in those

courses. Moreover, the inclusion of "interactive Maple practice sessions" for the Maple homework will provide the all MA 141, 241 and 242 students with an easily accessible on-line resource to help them find the cause of the mistakes they are making in their current homework assignment. Students will be able to access all the learning materials via the web so they will be available to the student 24 hours a day, 7 days a week.

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#### **8. Estimated number of students affected:**

Each semester approximately 3000 students enroll in the Engineering Calculus sequence of courses MA 141, MA 241 and MA 242, and all students in these courses are required to complete the Maple homework assignments. Thus roughly 3700 students (3000 from the fall semester, plus roughly 700 new MA 141 students in each spring semester) will be affected each academic school year by the project.

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#### **9. Outcomes of the Project:**

The main outcome of the project is that students taking MA 141, MA 241 and MA 242 will learn Maple more effectively. As a result overall grades for the Maple component, and hence overall grades themselves, will improve. There has been an impression among some students that Maple is difficult to learn and use, when in fact Maple is neither difficult to learn nor difficult to use. Students simply need to take the time and make the effort to do the homework assignments, and they will learn Maple. By providing more user friendly tools for the learning process, in particular on-line interactive Maple practice sessions and on-line lessons in QuickTime video format, we intend to enhance this learning process. Thus the project will impact both students' problem solving abilities as well as overall performance in MA 141, MA 241 and MA 242.

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#### **10. Project impact on NCSU:**

The suite of software tools used in the Maple program in the Department of Mathematics is "calculus independent". That is to say, the software uses "Maple to grade Maple", and hence could be used in Chemistry, Physics, Engineering, or in any discipline that uses Maple in any part of the curriculum.

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#### **11. Project Assessment Plan:**

The main outcome described above is that students will learn Maple more effectively, and hence that Maple grades as well as overall grades should improve compared with the grades from past semesters. We have all the materials from 2003 -2004 and 2004-2005 archived on eGrader, and we will use grades from those past semester to compare with grades from new semesters when the new technology tools are in place.

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#### **12. Staffing and Support:**

1. One or two students will be hired to do the data mining of the archived materials from 2003-2004 and 2004-2005, and to use the results to rewrite the

grading code for all problems currently used in MA 141, MA 241 and MA 242.

2. L.K. Norris will use software to create the interactive Maple practice sessions after the grading codes are updated. Norris will also create the QuickTime video versions of the Maple lessons for MA 241 and MA 242.

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**13. Financial Support Requested:**

**EPA salary total:** 6000

**SPA salary total:**

**Other salary:** 3500

**Equipment:**

**Cost associated with assessment:**

**Other financial support requested:**

**Total Funds requested:** 9500

**Additional Explanation of how funds will be used:**

I plan to hire student assistant(s) at \$12.50/hr for 280 hours for a total of \$3500. Roughly 140 hours of work for 2005-2006 and 140 hours for 2006-2007.

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**14. Funding Breakdown:**

**Total funding requested for fiscal year 2005-2006:** 1750

**Total funding requested for fiscal year 2006-2007:** 7750

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**15. Staff Support and/or Technical Support Requested:**

N/A

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**16. Timetable for Implementation:**

1. The initial data mining will occur between January and June 30, 2006.

2. During Fall 2006 student assistants will incorporate the results of the data mining into the grading code for the problems for MA 141, MA 241 and MA 242.

3. The work by Norris on creation of the interactive Maple practice sessions and the QuickTime video Maple Lessons will be done during the 2006-2007 academic year, plus May and June, 2007.

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**17. Human Subjects Protection:**

If your proposal project involves research using human subjects, you will need approval from the Institutional Review Board for the Protection of Human Subjects in Research (IRB) prior to final approval. IRB information is available at <http://www.ncsu.edu/sparcs/irb>



**18. Proposal Release:**

By submitting this proposal the applicant grants the LITRE Advisory Board

permission to make this proposal available as an example for future grant applicants. All personal information will be removed if this proposal is used as an example.

