A Model for a Liberal Arts Project-Based Capstone Experience

David R. Musicant (dmusican@carleton.edu), Jeff Ondich (jondich@carleton.edu), Carleton College

Our Constraints

Carleton College is a selective liberal arts school in Northfield, Minnesota, with a total enrollment of approximately 1800 students. Our computer science program has traditionally had approximately 15-20 majors each year, though we have recently seen a drop in enrollment comparable with our peer institutions. In constructing a capstone experience, we faced the following specific issues:

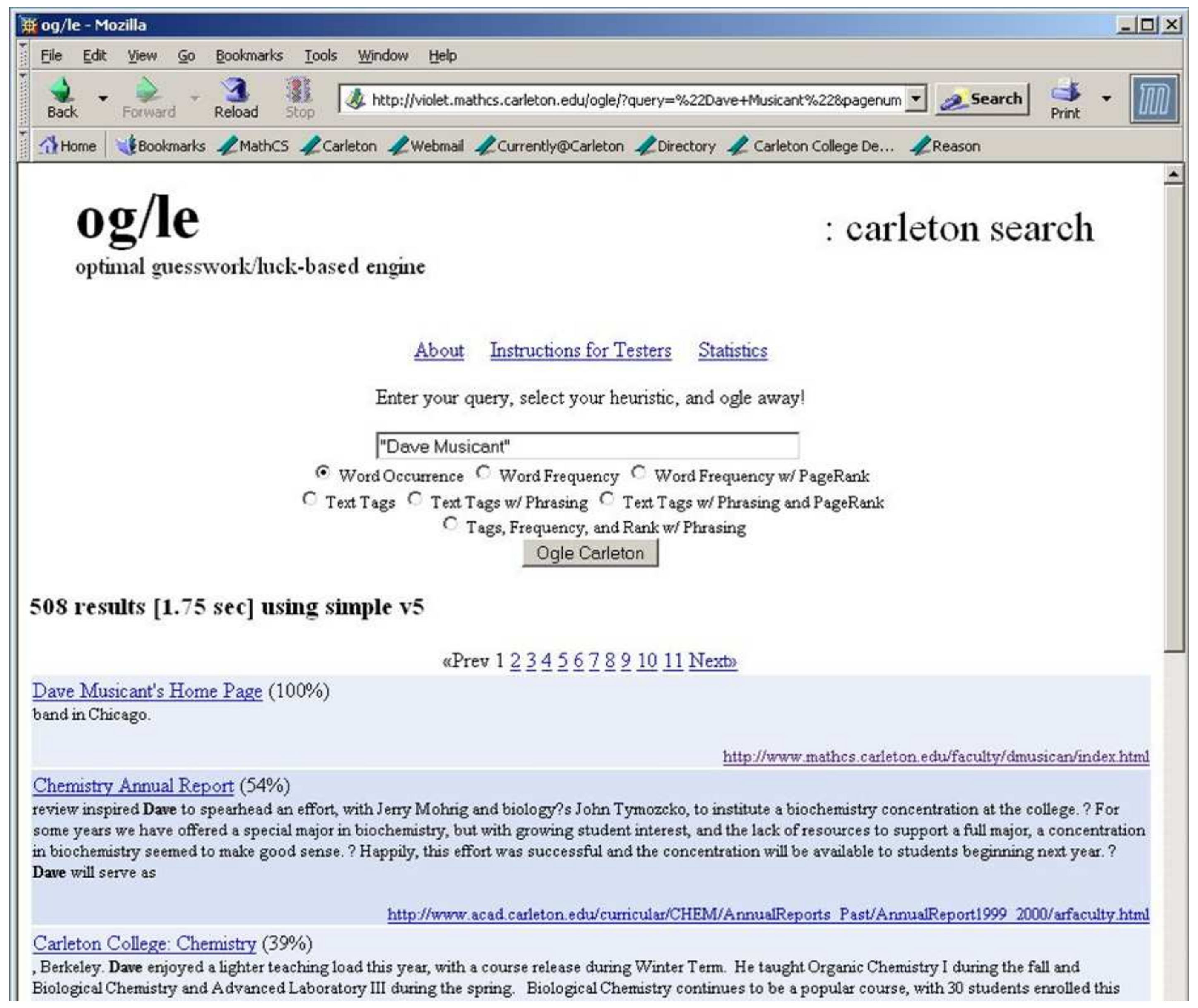
Required for all students. Our institution requires that each student on campus completes a capstone experience in each of his or her majors. The experience is expected to be challenging, and it should be possible to fail. It is generally expected, however, that almost all students will succeed. This is a complicated set of constraints to satisfy. At many other institutions, the capstone is either optional or is a department requirement only. At ours, if the student does not complete the project, the student does not graduate. We therefore need a system in which every student can participate and in which most can succeed, yet the real possibility for failure (i.e. not graduating) exists.

Individualized assessment. Some schools have implemented group-based capstone experiences, which is perhaps the obvious thing to do. Our institution, though, expects us to award a grade of "distinction" to those students who do exceptionally well on their capstone projects. Capstones at our institution are thus almost never handled as group projects, since such an arrangement makes it difficult to rate work done by an individual student. We therefore face practical and cultural barriers to group projects. Moreover, the capstone literature is scant when it comes to discussions on how to rate individual students when critical decisions such as graduation and distinction are tied in. We must be able to determine "distinctive" performance on an individual basis, and to be able to justify our decisions to our institution.

Strong theoretical component. Many schools that utilize group-based capstone projects do so by having the students implement software engineering projects. At a liberal arts institution such as ours, however, we must take extra care that we can justify to our College that we integrate significant amounts of computer science concepts and theory.

Limited Resources. We only have four faculty members who can advise computer science capstone projects. Advising individual students on capstone work is usually done as a teaching overload, though in recent years, more of our departments are moving to a system that awards teaching credit to comps advisors. Finding a way to advise all of our majors on capstones while retaining our sanity was of major concern. Moreover, another impact of our small size is that some of the wonderful (but large) capstone projects implemented at large institutions do not scale downward well.

Celebratory Conclusion. We believe that the end of the capstone experience should be celebratory.


og/le - Mozilla

File Edit View Go Bookmarks Tools Window Help

Back Forward Reload Stop http://violet.mathcs.carleton.edu/ogle/?query=%22Dave+Musicant%22&pagenum Search Print

Home Bookmarks MathCS Carleton Webmail Currently@Carleton Directory Carleton College De... Reason

og/le

optimal guesswork/luck-based engine

: carleton search

About Instructions for Testers Statistics

Enter your query, select your heuristic, and ogle away!

"Dave Musicant"

[✓ Word Occurrence] Word Frequency Word Frequency w/ PageRank
Text Tags Text Tags w/ Phrasing Text Tags w/ Phrasing and PageRank
Tags, Frequency, and Rank w/ Phrasing

Ogle Carleton

508 results [1.75 sec] using simple v5

«Prev 1 2 3 4 5 6 7 8 9 10 11 Next»

Dave Musicant's Home Page (100%)
band in Chicago.
http://www.mathcs.carleton.edu/faculty/dmusican/index.html

Chemistry Annual Report (54%)
review inspired **Dave** to spearhead an effort, with Jerry Mohrig and biology?s John Tymozcko, to institute a biochemistry concentration at the college. ? For some years we have offered a special major in biochemistry, but with growing student interest, and the lack of resources to support a full major, a concentration in biochemistry seemed to make good sense. ? Happily, this effort was successful and the concentration will be available to students beginning next year. ? **Dave** will serve as
http://www.acad.carleton.edu/curricular/CHEM/AnnualReports_Past/AnnualReport1999_2000/arfaculty.html

Carleton College: Chemistry (39%)
, Berkeley. **Dave** enjoyed a lighter teaching load this year, with a course release during Winter Term. He taught Organic Chemistry I during the fall and Biological Chemistry and Advanced Laboratory III during the spring. Biological Chemistry continues to be a popular course, with 30 students enrolled this

Project: Web search engine. Combines ideas from database systems, artificial intelligence, and networking. Integrates theoretical ideas from graph theory with database and network programming.

Our Solution

Though we conducted a literature search and spoke to a variety of colleagues at SIGCSE conferences, we failed to find a capstone experience that would adequately suit our needs as described above. We therefore synthesized ideas from a variety of them, and injected some ideas of our own, to produce the following system that we have found to be remarkably successful:

Advisor-specified projects that broadly integrate computer science with software engineering. To ensure that the projects involve a suitable mix of theory and practice, the faculty advisors (not the students!) carefully choose the project topics to make sure that elements of both exist. These projects typically span areas of advisor expertise or interest. Short descriptions of the four projects that we chose for our first year can be found at the bottom of this poster.

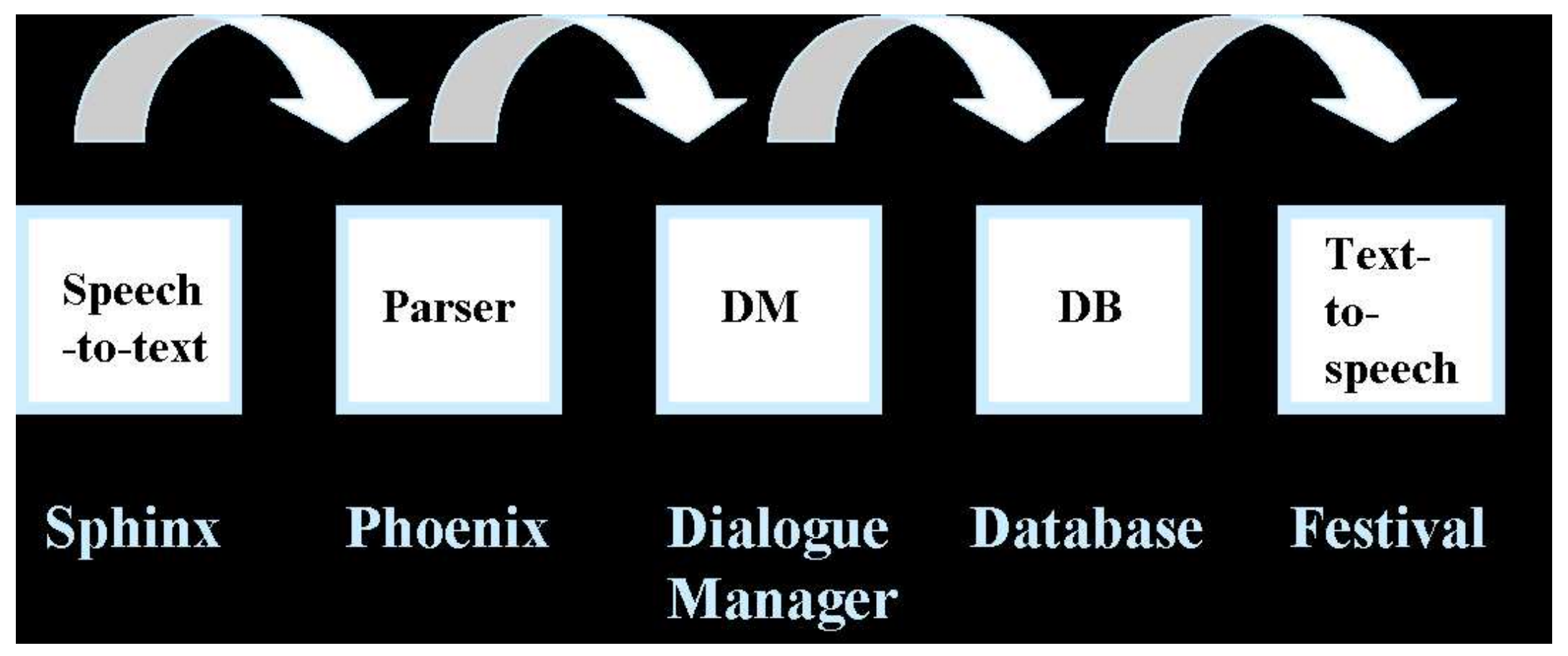
Teaching credit for advising capstones. We chose to equate advising two capstone groups as equal to teaching one course. We thus had to give up two of our courses to staff these capstones. We believe that the tradeoff was worth it.

Frequent meetings. Each team meets with its advisor twice per week to discuss progress and plan future directions. This helps to keep the students on track, and gives the faculty an opportunity to monitor the contributions of the individual team members.

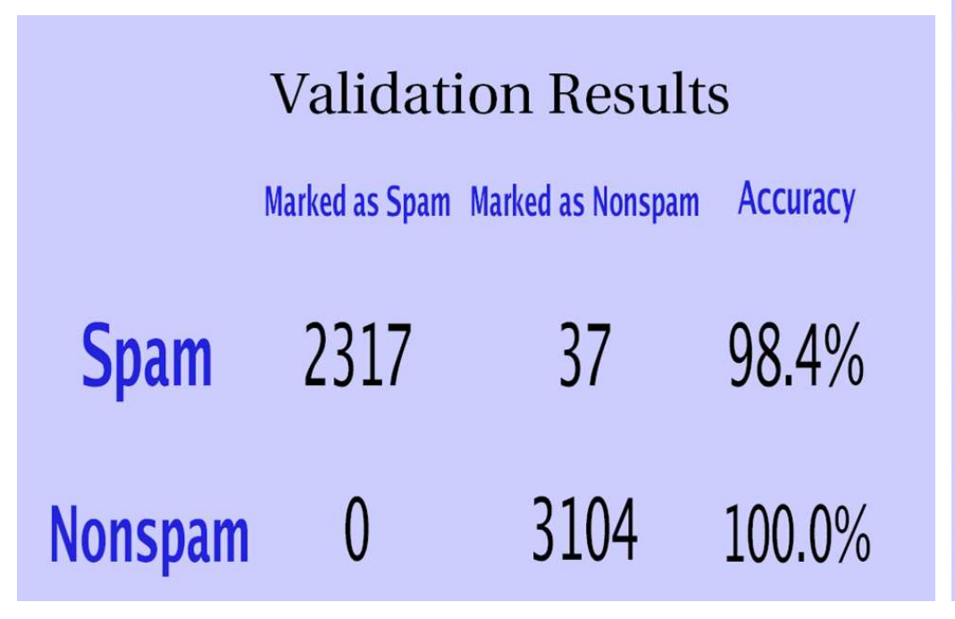
Peer evaluations. At the halfway point and at the end of the project, each student is asked to submit an evaluation form describing the contributions made by each of the other team members.

Individual interviews. Near the end of the projects, we conduct an individual interview with each student. We ask the students to summarize the team's work, and ask them detailed questions about their particular contributions.

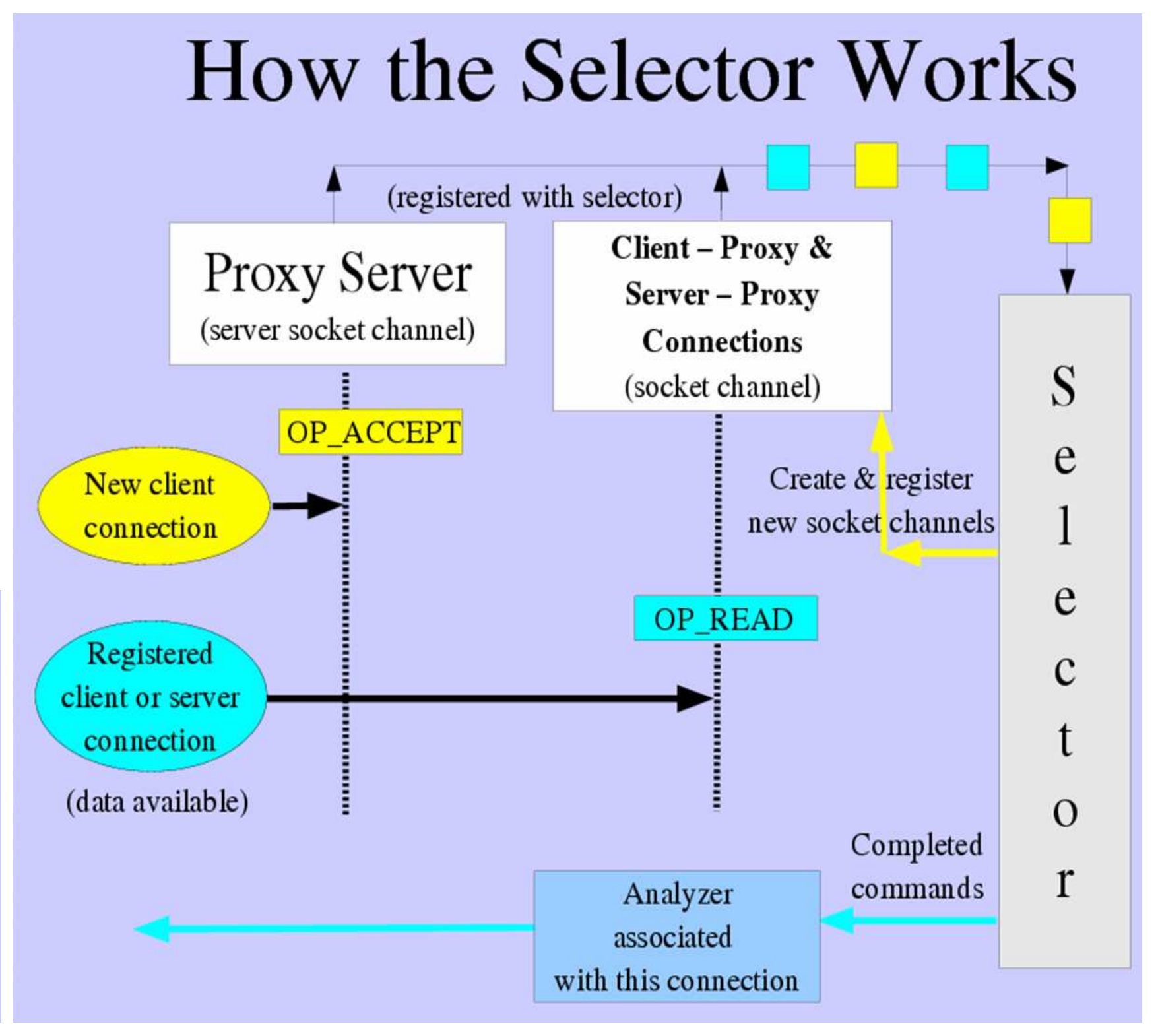
Final presentations. At the conclusion of the process, we hold a "mini-conference" in which each group gives an hour-long presentation on their work. This event is both technical and celebratory, and includes a catered lunch in the middle.



Project: Dialogue system to query a course registration database via voice commands. Combines ideas from natural language processing and database systems. Integrates theoretical ideas from speech recognition with software integration and database programming.


Validation Results

	Marked as Spam	Marked as Nonspam	Accuracy
Spam	2317	37	98.4%
Nonspam	0	3104	100.0%


How the Selector Works
(registered with selector)
Proxy Server
(server socket channel)
Client – Proxy & Server – Proxy Connections
(socket channel)
OP_ACCEPT
New client connection
Create & register new socket channels
OP_READ
Registered client or server connection
(data available)
Completed commands
Analyzer associated with this connection
Selector

Project: Spam filter that integrates with an email client. Combines ideas from database systems, artificial intelligence, and networking. Integrates theoretical ideas such as machine learning with database and network programming.

Sequence of Events

March of the students' junior year: Students are encouraged to submit ideas for project topics.

April: Topics, advisors, and timeslots are announced. Students submit preference rankings, and also identify one or two other students with whom they would like to work. We attempt to accommodate these requests but make no guarantees. The requests are often contradictory, and can also conflict with our efforts to balance the groups by ability level and personality.

May: Teams are assigned. We hold a kickoff meeting with the students, giving them an opportunity to interact with each other for the first time as a group. Summer readings are assigned.

September (beginning of our fall term): Students begin meeting twice a week with their advisors. The first 2-3 weeks are geared toward discussing the structure of the projects, software engineering guidelines, and specific tools for version tracking (e.g. CVS) and bug tracking (e.g. Mantis). The project advisors meet with both of their groups simultaneously for these initial meetings. After this period, the meetings are largely driven by progress reports and the need to make future plans.

October (midterm): Each project team submits a proposal document indicating a sequence of project goals, schedule, and design (including UML). Feedback is provided.

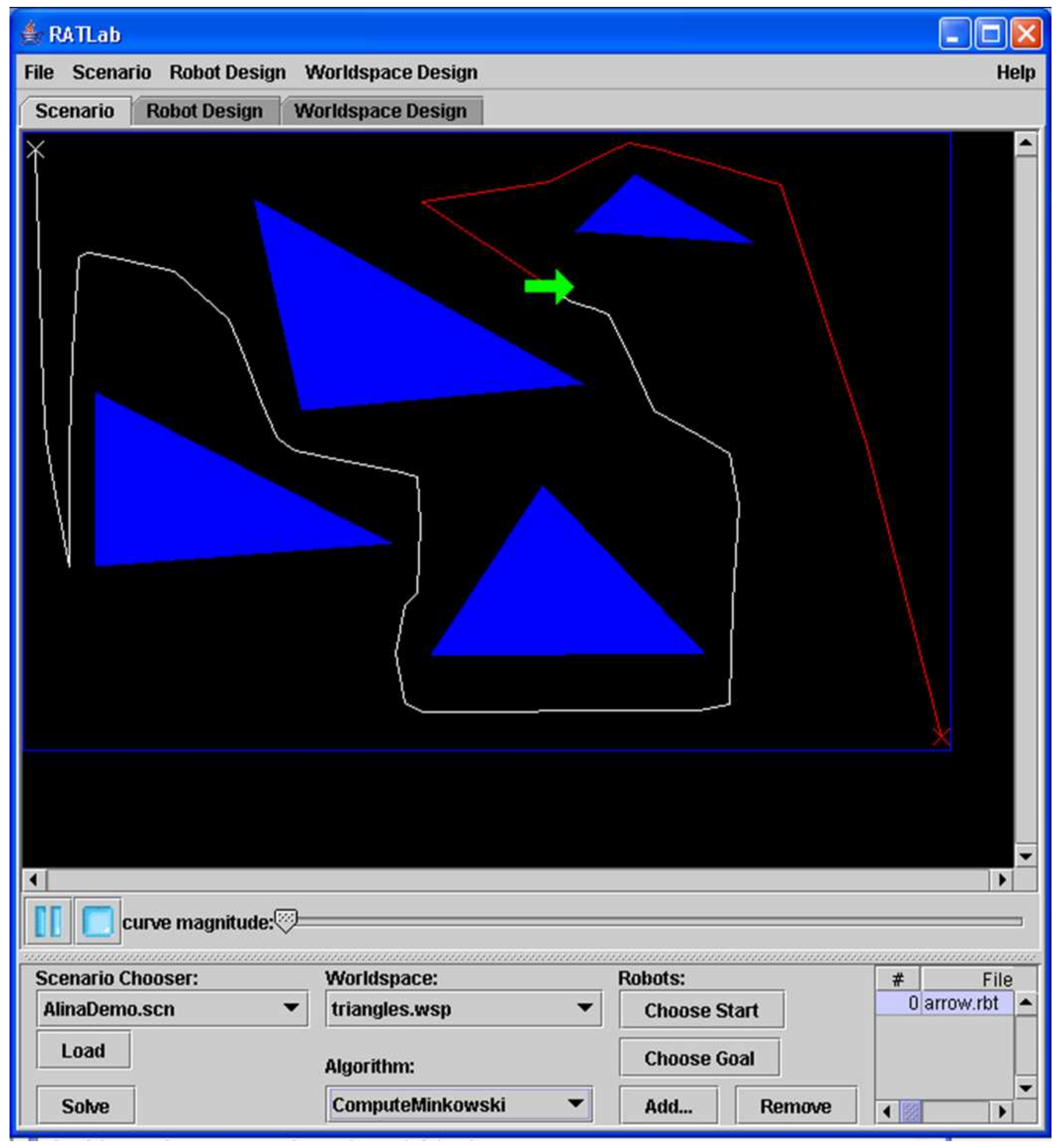
Thanksgiving (end of our fall term): The project team and the faculty member re-evaluate the schedule, and students submit peer evaluations.

January through March (our winter term): Project work and twice-weekly meetings continue.

March: Peer evaluations are submitted again, and individual interviews take place. The mini-conference is held. Students submit web pages documenting what they have accomplished, so that we may share their work with future generations of students. Grades of distinction, pass, and fail are determined for each student at a department meeting.

Conclusions

- Integrates theory and practice: students focus on a particular computing topic while working in a group
- Takes into account most of the relevant suggestions made in ACM Curriculum 2001, and satisfies a number of difficult constraints that arise when the capstone experience is a liberal arts graduation requirement
- Faculty members and students unanimously agreed that this system was an improvement of our previous one
- Material to use in recommendation letters about our students


RATLab

File Scenario Robot Design Worldspace Design Help

Scenario Robot Design Worldspace Design

curve magnitude:

Scenario Chooser: AlinaDemo.scn
Load
Solve

Worldspace: triangles.wsp

Algorithm: ComputeMinkowski

Robots: Choose Start Choose Goal Add... Remove

#	File
0	arrow.rbt

Project: Virtual motion planning system. Combines ideas from graphics, artificial intelligence, and algorithms. Integrates theoretical ideas on shortest-path planning with simulation programming.

Carleton College