

# COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) <small>(Indicate the most specific unit known, i.e. program, division, etc.)</small> <b>Division of Undergraduate Education</b>			FOR NSF USE ONLY <b>NSF PROPOSAL NUMBER</b>				
PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE <b>ILI-IP / November 1, 1995</b>							
DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	FILE LOCATION			
Employer Identification Number (EIN) or Taxpayer Identification Number (TIN) <b>IRS #381381271N</b>		Show Previous Award No. If This Is: <input type="checkbox"/> A Renewal or <input type="checkbox"/> An Accomplishment-Based Renewal		Is This Proposal Being Submitted To Another Federal Agency? YES ___ NO <u>X</u> If YES, List Acronym(s)			
Name of Organization to Which Award Should be Made: <b>Hope College</b>		Address of Awardee Organization, Including Zip Code: <b>Hope College P.O. Box 9000 Holland, MI 49422-9000</b>					
Awardee Organization Code (if known)							
Name of Performing Organization, If Different From Above		Address of Performing Organization, If Different, Including Zip Code:					
Performing Organization Code (if known)							
Is Submitting Organization: <input type="checkbox"/> For Profit Organization <input type="checkbox"/> Small Business <input type="checkbox"/> Minority Business <input type="checkbox"/> Woman Owned Business							
Title of Proposed Project <b>An Integrated Classroom/Laboratory for Introducing Students to Object Oriented Concepts</b>							
Requested Amount <b>\$ 46,356</b>		Proposed Duration (1-60 months) <b>24 months</b>		Requested Starting Date <b>June 1, 1996</b>			
Check Appropriate Box(es) If This Proposal Includes: <table style="width: 100%; border: none;"> <tr> <td style="width: 33%; vertical-align: top;"> <input type="checkbox"/> Vertebrate Animals  <input type="checkbox"/> Human Subjects  <input type="checkbox"/> Historical Places  <input type="checkbox"/> Beginning Investigator (See GPG Section I)  <input type="checkbox"/> Group Proposal  <input type="checkbox"/> Small Grant For Exploratory Research (SGER, See GPG Section II, C. 12)         </td> <td style="width: 33%; vertical-align: top;">           Any of the Items Listed Below:  <input type="checkbox"/> National Environmental Policy Act  <input type="checkbox"/> Proprietary and Privileged Information  <input type="checkbox"/> Disclosure of Lobbying Activities         </td> <td style="width: 33%; vertical-align: top;"> <input type="checkbox"/> Facilitation for Scientists/Engineers with Disabilities  <input type="checkbox"/> Research Opportunity Award  <input type="checkbox"/> International Cooperative Activity:         </td> </tr> </table>					<input type="checkbox"/> Vertebrate Animals <input type="checkbox"/> Human Subjects <input type="checkbox"/> Historical Places <input type="checkbox"/> Beginning Investigator (See GPG Section I) <input type="checkbox"/> Group Proposal <input type="checkbox"/> Small Grant For Exploratory Research (SGER, See GPG Section II, C. 12)	Any of the Items Listed Below: <input type="checkbox"/> National Environmental Policy Act <input type="checkbox"/> Proprietary and Privileged Information <input type="checkbox"/> Disclosure of Lobbying Activities	<input type="checkbox"/> Facilitation for Scientists/Engineers with Disabilities <input type="checkbox"/> Research Opportunity Award <input type="checkbox"/> International Cooperative Activity:
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P/PI Department <b>Computer Science</b>		P/PI Postal Address <b>Hope College Department of Computer Science P.O. Box 9000 Holland, MI 49422-9000</b>					
P/PI Fax Number <b>(616) 395-7123</b>							
Names (Typed)	Social Security No.*	High Degree, Yr	Telephone Number	Electronic Mail Address			
P/PI Name <b>Michael J. Jipping</b>	<b>371-62-8704</b>	<b>Ph.D., 1986</b>	<b>(616) 395-7509</b>	<b>jipping@cs.hope.edu</b>			
Co-P/PI <b>Herbert L. Dershem</b>	<b>371-62-8704</b>	<b>Ph.D., 1965</b>	<b>(616) 395-7507</b>	<b>dershem@cs.hope.edu</b>			
Co-P/PI <b>Gordon A. Stegink</b>	<b>371-38-0979</b>	<b>M.S., 1985</b>	<b>(616) 395-7508</b>	<b>stegink@cs.hope.edu</b>			
Co-P/PI							
Co-P/PI							
<b>NOTE: The FULLY SIGNED Certification Page must be submitted immediately following this Cover Sheet.</b>							
<small>*Submission of social security numbers is voluntary and will not affect the organization's eligibility for an award. However, they are an integral part of the NSF information system and assist in processing the proposal. SSN solicited under NSF Act of 1950, as amended.</small>							



# CERTIFICATION PAGE

## Certification for Principal Investigators and Co-Principal Investigators:

I certify to the best of my knowledge that:

- (1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and
- (2) the text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this application.

I understand that the willful provision of false information or concealing a material fact in this proposal or any other communication submitted to NSF is a criminal offense (U.S. Code, Title 18, Section 1001).

Name (Typed)	Signature	Date
PI/PD Michael J. Jipping		
Co-PI/PD Herbert L. Dershem		
Co-PI/PD Gordon A. Stegink		
Co-PI/PD		
Co-PI/PD		

## Certification for Authorized Institutional Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding Federal debt status, debarment and suspension, drug-free workplace, and lobbying activities (see below), as set forth in the Grant Proposal Guide (GPG), NSF 94-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

### Debt and Debarment Certifications

(If answer @yes<sup>a</sup> to either, please provide explanation.)

Is the organization delinquent on any Federal debt?

Yes \_\_\_ No X

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

Yes \_\_\_ No X

### Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding \$150,000.

### Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, Disclosure Form to Report Lobbying,<sup>a</sup> in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

AUTHORIZED INSTITUTIONAL REPRESENTATIVE		SIGNATURE	DATE
NAME/TITLE (TYPED) James M. Gentile			
TELEPHONE NUMBER (616) 395-7720	ELECTRONIC MAIL ADDRESS gentile@hope.edu		FAX NUMBER (616) 395-7123



NATIONAL SCIENCE FOUNDATION  
Division of Undergraduate Education

APPENDIX I

PROJECT DATA FORM

The instructions and codes to be used in completing this form begin on the next page.

1. Program to which the Proposal is Submitted: ILI-IP
2. Type of Submission: PR
3. Name of Principal Investigator/Project Director (as shown on the Cover Sheet):  
Michael J. Jipping
4. Name of Submitting Institution (as shown on the Cover Sheet)  
Hope College
5. Other institutions involved in the project's operation:  
\_\_\_\_\_

PROJECT CODES

- A. Major Discipline Code: 31 Subfields: Computer Education, Object Orientation
- B. Academic Focus Level of Project: UP
- C. Highest Degree Code: B
- D. Category Code: —
- E. Business/Industry Participation Code: —
- F. Audience Code: —
- G. Institution Code: PRIV
- H. Environmental Education Code: —
- J. Estimated Number of Undergraduate Students to be Directly Affected by the Activities of the Project During its Operation: 100
- K. Estimated Number of Pre-college Students to be Directly Affected by the Activities of the Project During its Operation: 0
- L. Estimated Number of College Faculty to be Directly Affected by the Activities of the Project During its Operation: 4
- M. Estimated Number of Pre-college Teachers to be Directly Affected by the Activities of the Project During its Operation: 0
- N. Total Non-NSF Contribution: \$46,356

Project Summary:

The Project Summary should be a concise description of the project limited to 22 lines of 12-point (standard pica type) or larger font on plain white paper.



## Project Summary

This proposal describes a project that will provide a seamless interface between the classroom and laboratory experiences in Software Design and Implementation, the second Computer Science course in the Hope College curriculum. This is done through the design of a combined classroom and laboratory that will contain ten computer workstations. These facilities will provide an ideal environment for cooperative and collaborative learning experiences facilitated by the latest computer equipment. The students will also learn to develop software in a modern environment and have access to that environment during all of the time the class meets for instruction. The facilities will also provide projection equipment to make the work being done by any student visible to the rest of the class. This laboratory classroom will enable the development of activities that combine lecture, discussion, group work, and laboratory work, all within a single class period.

The results of this project will be a set of exercises and activities that are designed to utilize this concept. The success of this concept will be assessed and the result will be disseminated via the Internet and World Wide Web, conference presentations, and papers.



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# Narrative

## 1 Introduction

This proposal describes a project that will provide a seamless interface between the classroom and laboratory experiences in Software Design and Implementation, the second Computer Science course in the Hope College curriculum. This is done through the design of a combined classroom and laboratory that will contain ten computer workstations. These facilities will provide an ideal environment for cooperative and collaborative learning experiences facilitated by the latest computer equipment.

This proposal requests \$46,356 for equipment to establish a classroom/laboratory combination to meet the needs of the Software Design and Implementation course. This will establish a working environment of eleven Sun workstations, ten student machines and one teaching station, and will include projection, communication and networking equipment. In addition to standard system software, each workstation will be equipped with in-house teaching and demonstration software. This combination classroom and laboratory will house this equipment in ways that facilitate teaching and experimentation in the same room, in ways unique to a Computer Science setting. To facilitate experimentation and manage the inherent risk, the new equipment will be on a subnetted network, separated from the department's general computing resources.

This proposal will be presented as follows. The current situation will be described: background on Hope College and the Computer Science department, and an explanation of how the current resources are inadequate for this project. Our project proposal will then be presented, followed by a description of the proposed equipment. Sections on biographies and dissemination plans follow. Descriptions of the course affected are given in the Appendix.

## 2 Current Situation and Background

### 2.1 Hope College and its Computer Science Department

Hope College is a four-year, liberal arts college, whose Science Division is one of the strongest divisions of its kind at any four-year college. The faculty and administration of Hope College believe that an effective curriculum is one augmented by active laboratory experiences and research participation by undergraduates. All of the science departments at Hope College actively seek ways to incorporate laboratory experiences and student research for which academic credit is awarded. For the past three summers, the Computer



Science Department has been one of four Hope College science departments with NSF REU summer research programs.

During the 13 year period from 1981-1994, the Computer Science Department graduated 190 majors. Of those, 34 attended graduate or professional school and 164 participated in a Research/Independent Study course during the academic year. Hope College strongly encourages faculty/student collaborative research. Undergraduate research with NSF support was carried out by more than 70 students during the summer of 1994 in the departments of Computer Science, Physics, Mathematics, Biology, and Chemistry. Institutional support for collaborative research outside of the sciences has increased by the establishment of a President's Discretionary Fund for this purpose.

## **2.2 Current Available Resources**

The resources currently available for the implementation of this project include those provided by the College for general computing and those owned and supported by the Computer Science Department for its instructional and research requirements.

Hope College provides computing facilities for general computer usage by all students, faculty and staff of the College. These facilities include two DEC Vaxstation 4000s that serve centralized campus information needs such as electronic mail and campus news and some word processing and computing needs. A third DEC Vaxstation 4000 automates the library card catalog and provides other information requirements. A network of 350 PC-compatible machines joins approximately 40 Apple Macintoshes via several local area networks to provide for most of the instructional, computing, and word processing needs of the campus.

The Computer Science department maintains its own computing facilities, providing students access to 14 Sun workstations. These machines are from two laboratories: a general computing facility that supports all class activities from the sophomore level on up, and a laboratory tailored for the experimentation needs of upper level classes. Because of a wide range of uses, each laboratory is equipped with a rich set of software development environments and machine configurations that support our curricular offerings.



## 2.3 The Need for Course Enhancement

### 2.3.1 Past and Present Development

The course under discussion was for many years a traditional three-hour Computer Science II course. The emphasis was on Software Design, and involved several large projects which were done in open labs outside of class time. The course migrated through languages (Pascal, Modula 2) and platforms (Vax, PC).

For several years, we have felt a strong need to move this course onto a Unix platform, and to expand coverage of the Unix environment. We offered a three-hour version in the spring semester of 1994 and the fall semester of 1994. In the spring semester of 1995, we added a closed lab, still with a three-hour course. In the fall semester of 1995, we expanded the course to a four-hour course and added the modified course to the regular curriculum. The title of the course is "Software Design and Implementation".

Content of the current course is with the catalog description in the Appendices. The support language is C++ with Unix workstations as the platform. In addition to the curriculum in Figure 1, there are 12 closed laboratories. Topics in the laboratories parallel the course with various programming concepts, design considerations, and implementation of some large projects. Several student-developed projects are required which are done in an open lab setting, separately from the scheduled labs.

The goals of this "Software Design and Implementation" course are as follows:

- Learn the techniques and practices of software design and implementation including top-down design, object-oriented principles, advanced programming concepts, and the use of software development tools.
- Gain substantial experience with the C++ programming language, the Unix operating system, and the World Wide Web on state-of-the-art workstations.
- Learn through cooperative, experimental, hands-on laboratories.

### 2.3.2 Frustrations in meeting our goals

*"The wide separation between lecture and laboratory is artificial and undesirable".* Our frustrations are not in course content, nor in the level of our students. Both are excellent, and the result of years of development. Our current frustrations are in methodology. We lecture (50 minutes) three days a week, and schedule a closed lab (80 minutes) once a week. We do not have the resources to schedule all four class sessions in our relatively small lab room. We have found that this results in a wide separation in style between what we do in lecture and what we do in lab. Further, we believe this separation is artificial and undesir-



able. What we seek is a seamless interface between lecture and laboratory. We want to introduce an idea in a lecture setting, and immediately have students, in teams, turn to their computer and work with that idea in a hands-on, experimental setting. We are frustrated by the lag time between lecture and lab. We believe the two to be sides of the same coin, and both must be done in the same setting.

*"We seek a seamless interface between lecture and laboratory"*. Detailed examples of how we intend to adapt current lab materials in a new setting will be given in section 3.

### **3 The Development Plan**

We have explained that our current resources provide our students with an inadequate laboratory for the projects we need to give. In addition, as we map out our solution -- the integrated classroom and laboratory -- we do not have the equipment necessary for this venture. This section will detail a proposed project that is designed to transform the current instructional environment into an integrated teaching and experimentation environment.

#### **3.1 The Project Description: A "Clabroom"**

We propose the design and construction of an instructional room which will permit a seamless interface between classroom and laboratory activities in the CSCI 225 course.

A present classroom will be renovated to become a "clabroom," a combination laboratory and classroom. It will be a classroom set up for computer science instruction with 24 movable seats, a display board and projection surface in the front of the room, and an instructor's workstation with projection capabilities. The classroom will also include, along its outer walls, ten work surfaces, each containing a workstation.

Instead of the class being scheduled with a lecture portion meeting for three 50-minute periods per week in a classroom and a laboratory portion meeting for one 80-minute period per week in a laboratory, the class will be scheduled for four 50-minute periods in the "clabroom," each period providing a mixture of classroom and laboratory experiences.

The instructor will move naturally between lecture, demonstration, discussion, and laboratory modes in the class. When a point is raised that needs reinforcement, the students will turn their chairs to their workstations where, in teams of 2 or 3 they will carry out the appropriate activity. The instructor will have the ability to project to the front display



screen the contents of any workstation's screen, in this way focusing the class attention on the work of any one of the groups.

The objectives of this project are to address the problems described in Section 2.3 by

1. Providing hardware and software of adequate quality and quantity to effectively support the laboratory and programming work in the CSCI 225 course.
2. Providing an environment that will eliminate the physical and chronological separation of the classroom and laboratory experiences.

We feel that the present project will adequately address the first objective by providing ten additional workstations with environments which are rich enough to support the laboratory and class work of 30 students without placing unreasonable limitations on the access of students in other courses that use the departmental network facilities.

We further address the second objective by the physical setting proposed for the laboratory. This environment will encourage new and innovative approaches to experiential, group learning and address the problems raised by the artificial separation of classroom and laboratory. It will also provide an environment where the students can continue their exploration and discussion outside of class time. It is Hope College's policy to make computers in classrooms available for open use during times when no class is scheduled in those rooms. That policy will apply to this room as well. Therefore, the CSCI 225 students will also use this room outside of class time for completing programming exercises assigned in the course and for further exploration into topics raised.

### 3.2 Use of the New Facilities

In this section, we will demonstrate how we will adapt current materials for use in the new facilities. The example is just one short selection from one lab (out of 12). The intent is not to show complete lab materials, but rather the style of the lab, and how we can better integrate all of the material with a "clabroom". The example is from the eighth lab, "Pointers, referencing, dereferencing, memory, files".

#### I. Pointers and two-dimensional arrays.

First, get a basic template program (first.cpp?) to work with. Declare a two-dimensional array of integers ( `int a[10][20]` ), and assign some data to some elements, and print out that data. The purpose here is just to be familiar with the syntax of these structures, not to prove their utility.

Now declare a one-dimensional array of strings, say `p`, and initialize it to the names of the days of the week.

What is the type of `*p`?



What is the type of p?

What is the type of p[3]?

Draw a picture of memory. You may use arrows to show how memory addresses are pointers to some location.

What is the value of \*p?

What is the value of \*(p+3)?

What is the value of p[5]?

Print out the names in the array using index notation: p[i]

Print out the names using pointer notation: \*(p+i)

What is the value of (\*(p+3)+2)?

What is the value of \*\*(p+1)?

What is the value of \*\*(p+4)?

What is the value of p[4][3]?

What is the value of p[0][5]?

Compute an integer array len containing the lengths of the elements of p, and print out the contents of the array len.

Print out in a doubly-nested for loop, character by character, the contents of p, using index notation: p[i][j]

Repeat, using pointer notation: \*(\*p+i)+j)

## II. Pointers and memory

Declare and initialize in exactly this order: three integers, an integer array x of length 5, and three more integers. Give all 11 locations unique values so that they are readily identified by value. (In other words, if we see a value of 57 we know right away which variable it is associated with.)

Our purpose now is to use pointers to discover how memory is allocated by the compiler.

First, write a loop to write out the addresses as well as the values of the array x. (These addresses will be in hexadecimal. Don't sweat that. It wouldn't hurt, however, to look at them carefully for some patterns.) Do this by initializing a pointer q to x, and print out both q and \*q, while incrementing the pointer on each iteration: q++

Now let's live dangerously and initialize q to x-1. First of all, be sure you understand what this means. It's a valid assignment, but it's not a very smart thing to do unless we are sure about it. The question is: what does x point to? Take a guess at the answer before continuing.

OK, run the program and find out the answer. Surprised? Write the answer.

Figure out how to initialize q so that we can print all 11 of the memory locations we have declared. This is printing memory in increasing locations. Draw a picture, showing the variable names as well as contents in these 11 locations. This picture should help to explain what happens when we [accidentally] go outside the bounds of an array.



Modify the program so that you can input the number of iterations of the loop so that you can print out as many locations as you desire. Run the program a few times with different values. Can you manufacture core dumps? Approximately how many iterations does it take to get a core dump?

Modify the program so that  $q$  is initialized "at the other end of the variables", and is decremented on each iteration of the loop ( $q--$ ). Now how many iterations does it take to get a core dump?

Give a brief summary of how the compiler allocates memory.

The material here takes about 3/4 of an hour in a closed lab setting. It would take longer in a "clabroom" setting, but it would also be spread out over several "clab" periods. Many of these items are perfect for class discussion, others are quick implementations, and others require some team discussion and reflection.

This brief sample of current materials demonstrates our style of using a lab. This style is ideally suited to a "clabroom", where lecturing and laboratory work are integrated.

### **3.3 Results and Workload Considerations**

This project will have the following results:

1. A combination classroom and laboratory will be constructed which will contain 10 workstations, one instructor's station, projection equipment, 30 moveable seats, and a white board. This room will be used for all meetings of CSCI 225.
2. Materials will be designed and implemented to make use of this environment in the class. These materials will be lesson plans which include a mixture of instructor presentation, instructor demonstration, student discussion, and student laboratory activities.
3. Software will be developed to facilitate the use of this environment. This will include software that will give the instructor an easy-to-use interface to enable all students to view windows that are on the screen of any station in the environment.

An assessment procedure will be developed to determine the effectiveness of this type of instructional environment.

We understand that the planning for this project, constructing the physical environment, and generated the materials described above will result in a considerable workload. To facilitate the project, we will actively seek funding, both internal and external, to provide release time for the principal investigators. The work will also be distributed among the three investigators.



## 4 Equipment

The budget and list of equipment necessary for this project is given on page 19. Based on the requirements of the proposed laboratory, a justification for the equipment request is given in this section.

Since section 3 has already outlined our rationale for the laboratory and has given some specifics on how we plan to construct it, we will only highlight here how the budgeted equipment meets the requirements of our projects:

- *The equipment adheres to our departmental standard workstation environment.* Our choice of Unix workstations reflects our use of this type of machine throughout our curriculum. This choice supports the students in the class as they move on in our department.
- *This equipment represents enough machines for up to 30 students.* The use of our “clabroom” will be by classes of 30 students or less. By putting three students per workstation, our “clab” will accomodate 30 students. Our goal however, is to have classes with teams of two or one, making the class size 20 or less. We will not go over 30 students.
- *The “clabroom” is equipped with a teaching station.* The eleventh workstation is a teaching station. This station will be equipped with locally-written software (already in progress) that will capture student screens for displaying on the teaching station or “take over” the student screen by letting the teacher guide the mouse and window manipulation from the teaching station. Such “chalkboard” software exists in part for PCs, but not for Unix workstations running X11 windowing systems.
- *The LCD monitor will display the teaching station screen.* The teaching station will also be able to display anything on its screen to the high-resolution LCD panel for the class to observe. Student output can also be redisplayed this way, as the teaching station can gather the contents of student screens as well as manipulate them.

In summary, this laboratory equipment provides what our current facilities, both general-use and upper level teaching labs, cannot: a set of flexible, configurable equipment designed to handle experimentation and collaboration in a integrated classroom/laboratory setting.



## 5 Faculty Expertise

The faculty of the Hope College Computer Science Department has gained extensive experience over the last six years in the development of laboratories. Much of this has been done with support from the National Science Foundation.

In 1989, Professor Gordon Stegink established a laboratory of six Sun Workstations to be used in the teaching of Computer Graphics. This laboratory was established with the assistance of an NSF ILI grant (USE-8951760). The equipment obtained for this project has since been updated and has been continuously used in an open lab setting to effectively support the teaching of computer graphics.

In 1990, Professor Mike Jipping established a Transputer laboratory for the teaching of parallel programming. This laboratory was equipped with the assistance of another NSF ILI grant (USE-9050417).

Professor Herb Dershem received a grant in 1992 from the DARPA sponsored program for Curriculum Development in Software Engineering and Ada, DARPA/CMO BAA 91-18. The project supported by this grant resulted in the development of a laboratory for the Data Structures courses. This laboratory included the use of the Ada programming language, algorithm animations, and the use of a test harness for experimental analysis of algorithms and data structures.

Since 1992, Professor Stegink has been actively developing a closed laboratory in our first computer science course, CSCI 120, Introduction to Computer Science. He has been an active member of the NSF project Adding Breadth and Laboratories to the Computer Science Curriculum. This project was coordinated by Bowdoin College, Clemson University, and the University of Connecticut. The philosophy of the laboratory developed by Stegink is to both augment programming concepts and introduce new compute science topics not normally covered in the introductory course. The laboratories, like the remainder of the course, focus the programming attention on graphical topics. Topics beyond programming which are covered in the laboratories include simulation, cellular automata, software testing, and fractal geometry. Three labs explore the diversity of platforms in use: PC/DOS, VAX/VMS, and Sun/Unix. The laboratories emphasize learning through exploration and experimentation and stress teamwork and cooperative learning.

In 1995, Professor Mike Jipping received a grant from the NSF ILI program (DUE-9550902) to establish a laboratory for operating systems and computer networking classes



at Hope College. This laboratory was placed in a separate physical location and established as a sub-network off of the departmental computer network. This sub-network is available for the laboratory students to use for experimentation. This lab provides a variety of platforms and is presently being used in the operating systems class as a semi-closed laboratory. This means students schedule their time in the lab during available times and laboratory assistants are on-call during these times. Two important features of these laboratory exercises is that they have been developed for World Wide Web presentation using Hot Java, and they facilitate experimentation, including rebooting machines and installing operating systems.

We believe that the proposed project is a natural extension of the work on both open and closed laboratories that has been carried out in the past. The principal investigators are experienced in the design and implementation of laboratories at all levels of the computer science curriculum.

## **6 Dissemination and Evaluation**

The results listed in section 3.3 will be innovative enough to be of interest to the academic community. Specifically, these are the lab materials, the "chalkboard" and laboratory software, and an assessment procedure. The lab materials and the assessment procedure can be combined and will be disseminated via educational research papers and presentations. The lab materials and the "chalkboard" software will be made available over the Internet to interested parties, in as many forms as possible. In fact, designing the necessary dissemination procedures (e.g., distribution over the World Wide Web) will make for interesting class discussion. Finally, the results of the entire project will be shared through consortia of which the principal investigators are members, specifically the Liberal Arts Computing Consortia and the Undergraduate Parallel Computing Consortium. These consortia are dedicated to curriculum development at the undergraduate level, making them an excellent arena for the sharing of experiences and data.

It is not clear at the present time exactly what form the assessment procedure mentioned above will take. It is clear that such an assessment must address issues of effectiveness of the combined classroom/laboratory approach and must gauge any new problem solving skills that the students may have acquired. We anticipate taking measures such as retaining output from student projects over several course offerings and formally surveying graduated alumni of both courses for their perceptions on the effectiveness of each course



in their employment or graduate school pursuits. These are among the alternatives under consideration.

## 7 Results from Previous NSF Support

Summaries from previous NSF work are given in section 5 above. In addition, the Computer Science department has received two REU grants, one completed in 1994, and one continuing through 1997.

Our projects have indeed been successful. In addition to the reports given in section 5, a bibliography of papers generated through these grants is given in the Appendices. Equipment from these grants remains in use today.



# Bibliography

The following is a bibliography of publications and presentations from the first two years of the Hope College REU Computer Science project at the time of the preparation of this proposal. Others are planned for the near future.

## 1 Papers presented

McFall\*, R. 1992. Using the Computer to Visualize and Simulate Abstract Models of Computation. Pew Midstates Consortium Undergraduate Research Symposium. Grinnell, IA., October

Shu\*, M. 1992. An Object-Oriented Application/Programmer Interface. Pew Midstates Consortium Undergraduate Research Symposium. Grinnell, IA.

Matthews\*, E. and M. Shield\*. 1992. Photosynthesis: An Object-Oriented Test Bed for Parallel Ray Tracing. Argonne Symposium on Undergraduate Research. Argonne, IL.

Howell\*, J., R. Wohlfarth\*, and M. Shu\*. 1993. An Object-Oriented Application/Programmer Interface for Network Programming. Symposium on Applied Computing. Indianapolis, IN.

Engel, G., H. Dershem, R. McFall\*, A. Lopez, and S. Wiltz. 1993. Research Experience for Undergraduates Panel. SIGCSE Technical Symposium on Computer Science Education. Indianapolis, IN.

Nelson\*, R. and B. Showers\*. 1993. The Genetic Algorithm Parallel Programming Project. Pew Midstates Consortium Undergraduate Research Symposium. Chicago, IL.

Barth\*, W. and C. Bowsher\*. 1993. AdaVision and THREADS: Algorithm Animations and Experimental Laboratories for Teaching a Data Structures Course in Ada. Argonne Symposium for Undergraduate Research. Argonne, IL.

Dershem, H. 1993. Algorithm Animation for Data Structures. United States Air Force Academy Computer Science Colloquium. USAF Academy, CO.

Jipping, M., S. Hallyn\*, M. Crider\*, N. Rahn\*, and J. Beard. 1993. An Empirical Case Study of Software Integration Techniques. NASA Langley Space Flight Center Symposium. Langley, VA.

McFall\*, R. and H. Dershem. 1994. Finite State Machine Simulation in an Introductory Lab. SIGCSE Technical Symposium on Computer Science Education. Phoenix, AZ.

Bowsher\*, C., D. Brown\*, and H. Dershem. 1994. The Use of a Test Harness in the Teaching of Data Structures. Argonne Symposium for Undergraduate Research. Argonne, IL.

## 2 Papers Published

M.J. Jipping, J.R. Toppen, and S. Weeber, "Concurrent Distributed Pascal: A Hands-on Introduction to Concurrency", *Proceedings of the 1990 SIGCSE Technical Symposium, SIGCSE Bulletin*, Vol. 22, No. 1 (February, 1990), pp. 94-99.



Howell\*, J., R. Wohlfarth\*, and M. Shu\*. "An Object-Oriented Application/Programmer Interface for Network Programming," Proceedings of the 1993 Symposium on Applied Computing, 1993.

McFall\*, R. and H. Dershem. "Finite State Machine Simulation in an Introductory Lab," SIGCSE Bulletin, 26,1 (1994), pp. 126-130.

Dershem, H., W. Barth\*, C. Bowsher\*, D. Brown\*. 1995. Data Structures with Ada Packages, Laboratories, and Animations. DARPA grant final report.



# Biographical Sketches

Principal Investigator: **Michael J. Jipping**

## • EDUCATION

Ph.D. in Computer Science, May 1986, The University of Iowa, Iowa City, Iowa 52242. Dissertation: "An Information-Based Methodology for the Design of Concurrent Systems". Advisor: Ray Ford.

M.S. in Computer Science, December 1984, The University of Iowa, Iowa City, Iowa 52242.

B.S. in Computer Science, May 1981, Calvin College, Grand Rapids, Michigan 49506.

## • PROFESSIONAL EXPERIENCE

*Assistant Professor*, Department of Computer Science, Hope College, Holland, Michigan 49423 (August, 1987 - present). Taught courses on introduction to programming and Pascal, software engineering, programming language concepts, operating systems, and parallel programming. Administered a departmental computing laboratory based in Unix workstations. Participated in departmental academic and research activities as well as personal research projects.

*Research Fellow*, NASA Langley Research Center, Information Systems Division, System Architecture Branch, Hampton, VA 23681 (June - August, 1992). Worked on a research team investigating software integration strategies.

*Assistant Professor*, Department of Computer Science, The University of Iowa, Iowa City, Iowa 52242 (August, 1986 - August, 1987). Taught courses on programming language concepts and compiler construction. Participated in departmental academic and research activities as well as personal research projects.

## • PUBLICATIONS AND REPORTS

M.J. Jipping, "Using Tcl as a ToolTalk Encapsulation Mechanism", *Proceedings of the 1993 Sun User Group Conference*, December 1993, pp. 161-174.

D.E. Eckhardt, M.J. Jipping, C.J. Wild, S.J. Zeil, and C.C. Roberts, "Open Environments to Support Systems Engineering Tool Integration: A Study Using the Portable Common Tool Environment (PCTE)", NASA Technical Memorandum 4489, NASA Langley Research Center, September 1993.

M.J. Jipping, "Developing a Formal Model for Concurrency Control Design", *Proceedings of the Second Great Lakes Computer Science Conference*, April 1991.

R. Ford, M.J. Jipping, R. Schultz, and B. Wenhardt, "On the Performance of Concurrent Tree Algorithms", *Journal of Parallel and Distributed Computing*, 8, March 1990, pp. 253-266.

M.J. Jipping, J.R. Toppen, and S. Weeber, "Concurrent Distributed Pascal: A Hands-on Introduction to Concurrency", *Proceedings of the 1990 SIGCSE Technical Symposium, SIGCSE Bulletin*, Vol. 22, No. 1 (February, 1990), pp. 94-99.

H.D. Dershem and M.J. Jipping, *Programming Languages: Structures and Models*, Wadsworth Publishing Co., 1990.



M.J. Jipping, and R. Ford, "Predicting Performance for Concurrency Control Design", *1987 ACM SIGMETRICS Conference on Measurement and Modeling of Computer Systems*, pp. 132-142, Banff, Alberta, Canada (May 1987).

M.J. Jipping and R. Ford, "Performance Prediction in Distributed System Design", *Proceedings of the 1986 Rockwell International Software Engineering Symposium*, pp. 3.2.1-3.2.8, Cedar Rapids, Iowa (October 1986).

M.J. Jipping, "An Information-Based Methodology for the Design of Concurrent Systems", Ph.D. Thesis, Technical Report 86-01, The University of Iowa, Iowa City, Iowa (May 1986).

#### • RESEARCH GRANT AWARDS

Recipient of a NASA /JOVE Augmentation Award, June 1995 - September, 1996, \$17,600.

M.J. Jipping, "Building a Software Infrastructure for Parallel Software Design", NASA Langley Research Center, NAG-1-1480, February 1993 - January 1996.

Recipient of a NASA Joint Venture Award, June 1992 - May 1995, \$45,000.

M.J. Jipping, "Metrics for Concurrent System Design", Hope College Faculty Development Grant, June-August, 1991.

M.J. Jipping, "Refining a Metric for Concurrent System Design", Hope College Faculty Development Grant, June-August, 1990.

M.J. Jipping, "A New Course in Parallel Programming for Undergraduates", NSF Grant No. USE-9050417, Instrumentation and Laboratory Improvement Program, \$54,761, July, 1990.

M.J. Jipping, "Creating an Environment for Parallel Programming", Hope College Faculty Development Grant, June-August, 1989.

#### • SUMMARY OF UNDERGRADUATE INVOLVEMENT

A total of 57 undergraduate students have been advised by Dr. Jipping.

12 students have conducted research with Dr. Jipping.

#### • COLLABORATION

A list of scientists collaborated with on projects over the last 48 months would include: Herbert Dershem, G. Michael Schneider, Chris Colgate, Tom Whaley, Henry Walker, Kim Bruce, Robert Cupper, James Bradley, Allen Tucker, and Raymond Ford.



## Co-Principal Investigator: **Herbert L. Dershem**

### • **EDUCATION**

B.S. University of Dayton, 1965  
M.S. (Computer Science) Purdue University, 1967  
Ph.D. (Computer Science) Purdue University, 1969

### • **PROFESSIONAL EXPERIENCE**

Assistant Professor, Hope College, 1969-1974  
Associate Professor, Hope College, 1974-1981  
Professor, Hope College, 1981-  
Visiting Research Scientist, Oak Ridge National Laboratories, 1977-1978  
Visiting Professor, Boston University Overseas Program, 1982-1983  
Distinguished Visiting Professor, United States Air Force Academy, 1993-1994

### • **HONORS AND AWARDS**

NDEA Fellow, Purdue University, 1965-1968  
Project COMPUTe Awardee, Dartmouth College, 1972  
NASA/ASEE Summer Fellow, Goddard Space Flight Center, 1976  
Oak Ridge Associated Universities Summer Fellow, 1977

### • **GRANTS**

Co-director, "Introduction of the Computer in the Statistics Curriculum," NSF Office of Computing Activities, 1971-73  
Director, "A Modular Approach to the Introductory Course in Computer Science," NSF Local Course Improvement Program, 1978-1980  
Co-Director, "A Microcomputer Laboratory for use in Teaching Statistics," NSF Instructional Scientific Equipment Program, 1979-1980  
Director, "CSNET Membership in Support of Computer Science Research," NSF RUI Program, 1987-1990  
Director, "REU: An Undergraduate Research Participation Program in Computer Science," NSF CISE, 1992-1994  
Director, "Use of Ada, Laboratories, and Visualization in the Teaching of Data Structures and Discrete Mathematics," DARPA Curriculum Development Grant, 1993-1994  
Director, "Curriculum and Textbook Development Using Ada 9X for the Teaching of Object-Oriented Concepts," U.S. Air Force Contract, 1994-1996  
Director, "REU: An Undergraduate Research Participation Program in Computer Science," NSF CISE, 1995-1997



• **PUBLICATIONS (24 total, those since 1989 included below)**

*Programming Languages: Models and Structures*, H. Dershem and M. Jipping, Wadsworth Publishing Company, 1990

"Finite State Machine Simulation in a Introductory Lab," Ryan McFall and Herbert L. Dershem, *Proceedings of the 1994 SIGCSE Technical Symposium, SIGCSE Bulletin*, 26,1,126-130, March, 1994

*Programming Languages: Models and Structures, Second Edition*, H. Dershem and M. Jipping, PWS Publishing, 1995



## Co-Principal Investigator: **Gordon A. Stegink**

### • **EDUCATION**

Hope College, A.B., Mathematics, 1961  
Washington University, A.M., Mathematics, 1963  
Washington University, PhD Course work, Mathematics, 1963-1965  
State University of Pennsylvania, Computer Science, 1967-1968  
Purdue University, Visiting Scholar in Computer Science, 1988

### • **PROFESSIONAL EXPERIENCE**

Assistant Professor, Dickinson College, 1965-1970  
Director of the Computer Center, Dickinson College, 1967-1970  
Assistant Professor, Grand Valley State University, 1970-1974  
Manager of Computer Operations and User Services, Grand Valley State University, 1970-1981  
Assistant Professor, Hope College, 1981-1987  
Associate Professor, Hope College, 1987-present  
Acting chair of Computer Science, Hope College, 1982-1983; 1988; 1993-1994  
Visiting Associate Professor, University of Malawi (Africa), 1990-1991

### • **MEMBERSHIPS IN PROFESSIONAL SOCIETIES**

Association of Computing Machinery  
Special Interest Group Computer Graphics (SIGGRAPH)  
Special Interest Group Computer Science Education (SIGCSE)

### • **GRANTS RECEIVED**

National Science Foundation. ILIP, \$78,000 to establish a Computer Graphics Laboratory, 1989  
Pew Charitable Trust. \$11,000 for a Faculty Development Workshop on Fractal Geometry, 1989  
Knight Foundation. \$2,500 to develop laboratories for a first course in Computer Science, 1992  
Fulbright Lectureship. University of Malawi, Malawi, Africa, 1990-91 academic year  
National Science Foundation. Participant in the CLUB (Clemson, U Conn, and Bowdoin) project for Adding Laboratories and Breadth in the curriculum



## • OTHER RECENT ACTIVITIES

Reviewed "An Invitation to Computer Science", by Schneider and Gersting for West Publishing Co., 1994

Served on a panel "Alternative Teaching Strategies: Supporting Diversity" at ACM/SIGCSE, 1995, Nashville



## ILI-IP DETAILED BUDGET (EQUIPMENT LIST) FORMAT

Item (Descriptive name, probable brand and model)	How Many	Unit Price (List)	Unit Price (Discounted)	Total Cost (Discounted)
SPARCstation 5 • 110 MHz processor • 32 MBytes memory, 1.0 Gbytes disk	11	\$10,522	\$5,757	\$63,327
CenterLine ObjectCenter • Version 4.0.1	11	\$2,000	\$1,000	\$11,000
SPARCworks Visual • 32 MBytes memory, two 1.0 GByte disks	11	\$2,995	\$495	\$5,445
LCD Monitor Interface	1	\$11,500	\$11,500	\$11,500
CD-ROM Drive	1	\$600	\$400	\$400
Volks Twisted Pair MiniHub	2	\$270	\$270	\$540
Miscellaneous Cabling		\$500	\$500	\$500

Total project cost: \$92,712

Non-NSF contribution  
(including any overmatch): \$46,356

NSF request: \$46,356

Use additional pages(s) if needed.



## CURRENT AND PENDING SUPPORT

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: **Michael J. Jipping**

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ \*Transfer of Support

Project/Proposal Title:

**An Integrated Classroom/Laboratory for Introducing Students to Object Oriented Concepts**

Source of Support: NSF

Award Amount (or Annual Rate): \$ 46,356

Period Covered: 6/96 through 5/98

Location of Project: Hope College

Person-Months Committed to the Project. Cal: Acad: 2 Summ:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ \*Transfer of Support

Project/Proposal Title:

**A Laboratory for Experimenting with Operating Systems and Networking Concepts**

Source of Support: NSF

Award Amount (or Annual Rate): \$ 52,601

Period Covered: 6/95 through 5/98

Location of Project: Hope College

Person-Months Committed to the Project. Cal: Acad: 2 Summ:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ \*Transfer of Support

Project/Proposal Title:

**NASA/Jove Augmentation Grant**

Source of Support: NASA

Award Amount (or Annual Rate): \$ 17,981

Period Covered: 6/96 - 7/96

Location of Project: Hope College

Person-Months Committed to the Project. Cal: Acad: Summ: 2

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ \*Transfer of Support

Project/Proposal Title:

**NASA/Jove Hope College Participation**

Source of Support: NASA

Award Amount (or Annual Rate): \$ 63,000

Period Covered: 6/92-5/95

Location of Project: Hope College

Person-Months Committed to the Project. Cal: Acad: 1 Summ: 1

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ \*Transfer of Support

Project/Proposal Title:

**Building a Software Infrastructure for Parallel Software Design**

Source of Support: NASA

Award Amount (or Annual Rate): \$ 83,500

Period Covered: 2/93 - 1/96

Location of Project: Hope College

Person-Months Committed to the Project. Cal: Acad: 1 Summ: 1

\*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.



## CURRENT AND PENDING SUPPORT

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: <b>Herbert L. Dershem</b>	Other agencies (including NSF) to which this proposal has been/will be submitted.
---	---

Support: ☒ Current   ☐ Pending   ☐ Submission Planned in Near Future   ☐ \*Transfer of Support  
 Project/Proposal Title:

**REU: An Undergraduate Research Participation Project in Computer Science**

Source of Support: **NSF REU**

Award Amount (or Annual Rate): **\$114,393**      Period Covered: **3/94 - 9/96**

Location of Project: **Hope College**

Person-Months Committed to the Project.      Cal:      Acad: **0.5**      Summ: **2**

Support: ☒ Current   ☐ Pending   ☐ Submission Planned in Near Future   ☐ \*Transfer of Support  
 Project/Proposal Title:

**Curriculum and Textbook Development using Ada 9X for the Teaching of  
Object Oriented Concepts**

Source of Support: **US Air Force**

Award Amount (or Annual Rate): **\$34,464**      Period Covered: **6/95 - 8/96**

Location of Project: **Hope College**

Person-Months Committed to the Project.      Cal:      Acad:      Summ: **2**

Support: ☐ Current   ☐ Pending   ☐ Submission Planned in Near Future   ☐ \*Transfer of Support  
 Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): \$      Period Covered:

Location of Project:

Person-Months Committed to the Project.      Cal:      Acad:      Summ:

Support: ☐ Current   ☐ Pending   ☐ Submission Planned in Near Future   ☐ \*Transfer of Support  
 Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): \$      Period Covered:

Location of Project:

Person-Months Committed to the Project.      Cal:      Acad:      Summ:

Support: ☐ Current   ☐ Pending   ☐ Submission Planned in Near Future   ☐ \*Transfer of Support  
 Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): \$      Period Covered:

Location of Project:

Person-Months Committed to the Project.      Cal:      Acad:      Summ:

\*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.



## Major Departmental Equipment

The Computer Science hardware facilities are currently comprised of 16 Sun workstations. These are shown in the table below:

Machine/Part	Peripherals (if any)
Sun SPARCserver 1000E	64 MBytes memory, 7 GBytes disk space, CD-ROM drive, 8mm Exabyte backup unit
Sun 4/360	32 MB memory, 1.0 GBytes disk space, CD-ROM drive
Sun 4/470	32 MB memory, 669 MB and 1.3 GByte disk drives, CD-ROM drive, SCSI tape drive
(4) Sun SPARCstation 10s	32 MB memory, 3.5" floppy drives, GX graphics coprocessor, 500 MB and 1 GB disk drives
(8) Sun SPARCstation 5s	32 MB memory, 3.5" floppy drives, GX graphics coprocessor, 1 GB disk drive
(2) Sun SPARCstation 20s	32 and 64 MB memory, 1.0 GB disk drive, 3.5" floppy
(2) Sun SPARCstation 1+s	16 MB memory, 3.5" floppy drive, GX graphics coprocessor, 500 MB disk drive
(32) INMOS Transputers	These are parallel processing units housed in the Sun 4/470

A 8mm backup unit -- an Exabyte tape drive -- is connected to the Sun 4/360 file server. The lab has one laser printer, an HP LaserJet 4M Plus, and four Epson dot-matrix printers (various models). The lab has five modems: two 14,400-baud modems, and 3 28,800-baud modems connected to a Livingston Portmaster terminal server.

Lab software includes the standard Sun Unix operating system and documentation, windowing system, and reference material. Unbundled components include C and C++ compilers, word processors, and code debugging environments. Parallel tools have been purchased for working with the parallel Transputer environment. Many public domain tools are in use.

The departmental lab's software and hardware provide access to the Internet. These facilities also provide access to campus Vaxes through an Ethernet bridge.

The lab is currently administered by one individual. About 7 hours per week are devoted to lab administration. Both software and hardware administration is handled by this individual. Operator duties, e.g., file system backups and preventative maintenance are mostly automated. The department handles maintenance of its facilities by itself. It negotiates maintenance contracts, keeps on hand supplies for its printers and other peripherals,



provides the "raw materials" (e.g., cable, connectors, etc.) and tools for hardware maintenance, and maintains a "spare parts machine" for computer hardware maintenance.

CSCE 325 - Software Design and Implementation - An introduction to the techniques and practices of software design and implementation, including top-down design, object-oriented principles, advanced programming concepts, and the use of software development tools. Students will gain substantial experience with the C++ programming language and the Unix operating system on state-of-the-art workstations. This course will meet for three lectures and one laboratory per week. Prerequisite: Computer Science 130 or equivalent. Four hours.

Course Content	
1. Introduction to Classes (4 periods)	Objects and classes Programming with classes Data types Operators and expressions Statements Functions Files and libraries
2. Control Structures (3 periods)	Selection, Iteration
3. Compound Data (4 periods)	Structures, Arrays
4. Derived Classes (3 periods)	Pointers, Storage, Structures
5. Data Structures (5 periods)	Linked Lists, Queues, Stacks, Trees
6. Software Engineering (2 periods)	7. Inheritance (3 periods)
8. Working with classes (1 period)	9. Algorithms (4 periods)
10. Abstract classes (4 periods)	Abstract data types



# Catalog Descriptions of Courses Affected by This Proposal

The following are descriptions of the course affected by this proposed project as they might appear in the Hope College catalog.

**CSCI 225 -- Software Design and Implementation** -- An introduction to the techniques and practices of software design and implementation, including top-down design, object-oriented principles, advanced programming concepts, and the use of software development tools. Students will gain substantial experience with the C++ programming language and the Unix operating system on state-of-the-art workstations. This course will meet for three lectures and one -laboratory per week. Prerequisite: Computer- Science 120 or equivalent. Four hours.

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## Course Content

---

### 1. Introduction to Classes (6 periods)

*Objects and classes*  
*Programming with classes*  
*Data types*  
*Operators and expressions*  
*Statements*  
*Functions*  
*Files and libraries*

### 2. Control Structures (3 periods)

*Selection, Repetition*

### 3. Compound Data (4 periods)

*Structures, Arrays*

### 4. Derived Classes (5 periods)

*Pointers, Strings, Streams*

### 5. Data Structures (5 periods)

*Lists, Queues, Stacks, Trees*

### 6. Software Engineering (2 periods)

### 7. Inheritance (5 periods)

*Base and derived classes*  
*Access control*  
*C++ string library*  
*Streams and files*

### 8. Working with classes (1 period)

### 9. Algorithms (4 periods)

*Searching algorithms*  
*Sorting algorithms*  
*Analysis of algorithms*

### 10. Abstract classes (4 periods)

*Abstract data types*



## Major Data

Year	Graduating Majors	Graduates Attending Grad School	Independent Study and Research Projects
1983-84	16	2	22
1984-85	29	3	34
1985-86	18	2	12
1986-87	15	3	5
1987-88	16	2	17
1988-89	8	4	9
1989-90	14	3	10
1990-91	14	1	14
1991-92	12	6	2
1992-93	8	2	5
1993-94	4	1	2
1994-95	7	3	4
1995-96 (est.)	14	4	4



# Major Data

Year	Continuing Major	Continuing Assisting Grad School	Independent Study and Research Projects
1962-63 (est.)	14	4	1
1964-65	5	1	4
1965-66	4	1	3
1967-68	8	3	2
1968-69	13	6	3
1969-70	14	1	10
1970-71	14	1	10
1971-72	13	6	3
1972-73	8	3	2
1973-74	4	1	3
1974-75	5	1	4
1975-76	10	10	33
1976-77	13	3	8
1977-78	14	2	15
1978-79	15	2	15
1979-80	15	3	34
1980-81	16	3	33



NATIONAL SCIENCE FOUNDATION  
4201 WILSON BOULEVARD • ARLINGTON, VIRGINIA 22230

Award Date  
Grant No.  
Proposal No.

June 13, 1996  
DUE-9650129  
DUE-9650129

RECEIVED

JUN 18 1996

PRESIDENTS OFFICE  
Hope College

Dr. John H. Jacobson  
President  
Hope College  
P.O. Box 9000  
Holland, MI 49423-9000

Dear Dr. Jacobson:

The National Science Foundation hereby awards a grant of \$46,356 to Hope College for support of the project described in the proposal referenced above.

This project, under the direction of Michael J. Jipping, Herbert L. Dershem and Gordon A. Stegink, Department of Computer Science, is entitled:

"An Integrated Classroom/Laboratory for Introducing Students to Object Oriented Concepts."

This award is effective June 15, 1996 and expires May 31, 1998.

This grant is awarded pursuant to the authority of the National Science Foundation Act of 1950 (42 U.S.C. 1861 et seq.) and is subject to GC-1 Grant General Conditions (10/95) and the following terms and conditions:

As a condition of this award, the grantee agrees to share in the costs of the project in the amount of at least one-half of total costs.

The attached budget indicates the amounts, by categories, on which NSF has based its support.

The cognizant NSF program official for this grant is Michael C. Mulder (703) 306-1670. The cognizant NSF grants official is Ramona M. Lauda (703) 306-1218.

Sincerely,

H. D. Wolff  
Herbert D. Wolff, III  
Grants Officer





**HOPE COLLEGE**

OFFICE OF THE PRESIDENT

June 19, 1996

Mr. Herbert D. Wolff, III, Grants Officer  
National Science Foundation  
4201 Wilson Boulevard  
Arlington, VA 22230

Dear Mr. Wolff:

SUBJECT: Grant # DUE-9650129  
Proposal # DUE-9650129

I am pleased to acknowledge your letter of June 13, 1996, regarding the grant award of \$46,356 for the support of a project directed by Michael J. Jipping, Herbert L. Dershem, and Gordon A. Stegink which is entitled:

"An Integrated Classroom/Laboratory for Introducing  
Students to Object Oriented Concepts."

The award became effective on June 15, 1996, and will expire on May 31, 1998.

We pledge our best efforts to use those resources wisely and in accordance with the terms and conditions set forth.

With all good wishes,

John H. Jacobson, President

JHJ/km

pc: Dr. Jacob E. Nyenhuis, Provost  
Dr. Michael J. Jipping, Associate Professor of Computer Science  
✓ Dr. Herbert L. Dershem, Professor of Computer Science  
Dr. Gordon A. Stegink, Associate Professor of Computer Science  
Dr. James M. Gentile, Dean for the Natural Sciences  
Mr. Barry Werkman, Controller



NATIONAL SCIENCE FOUNDATION  
4201 WILSON BOULEVARD • ARLINGTON, VIRGINIA 22230

- 2 -

DUE-9650129

SUMMARY PROPOSAL BUDGET

	PERSON MOS			Funds granted
	cal	acad	sumr	By NSF
A. ( 0.00) Total Senior personnel	0.00	0.00	0.00	\$0
B. Other Personnel				
1. ( 0.00) Post doctoral associates	0.00	0.00	0.00	\$0
2. ( 0.00) Other professionals	0.00	0.00	0.00	\$0
3. ( 0.00) Graduate students				\$0
4. ( 0.00) Secretarial-clerical				\$0
5. ( 0.00) Undergraduate students				\$0
6. ( 0.00) Other				\$0
Total salaries and wages (A+B)				\$0
C. Fringe benefits (if charged as direct cost)				\$0
Total salaries wages and fringes (A+B+C)				\$46,356
D. Total permanent equipment				\$0
E. Travel 1. Domestic				\$0
2. Foreign				\$0
F. Total participant support costs				\$0
G. Other direct costs				\$0
1. Materials and supplies				\$0
2. Publication costs/page charges				\$0
3. Consultant services				\$0
4. Computer (ADPE) services				\$0
5. Subcontracts				\$0
6. Other				\$0
Total other direct costs				\$46,356
H. Total direct costs (A through G)				\$0
I. Total indirect costs				\$46,356
J. Total direct and indirect costs (H+I)				\$46,356
K. Residual funds / Small business fee				\$0
1. Residual funds (if for further support of current projects GPM 252 and 253)				\$0
2. Small business fee				\$46,356
L. Amount of this request (J) or (J - K1 + K2)				\$46,356
M. Cost sharing				\$46,356



NATIONAL SCIENCE FOUNDATION  
4201 WILSON BOULEVARD • ARLINGTON, VIRGINIA 22230

- 2 -

DUE-9650129

SUMMARY PROPOSAL BUDGET

	PERSON MOS			Funds granted
	cal	acad	sumr	By NSF
A. ( 0.00) Total Senior personnel	0.00	0.00	0.00	\$0
B. Other Personnel				
1. ( 0.00) Post doctoral associates	0.00	0.00	0.00	\$0
2. ( 0.00) Other professionals	0.00	0.00	0.00	\$0
3. ( 0.00) Graduate students				\$0
4. ( 0.00) Secretarial-clerical				\$0
5. ( 0.00) Undergraduate students				\$0
6. ( 0.00) Other				\$0
Total salaries and wages (A+B)				\$0
C. Fringe benefits (if charged as direct cost)				\$0
Total salaries wages and fringes (A+B+C)				\$0
D. Total permanent equipment				\$46,356
E. Travel				\$0
1. Domestic				\$0
2. Foreign				\$0
F. Total participant support costs				\$0
G. Other direct costs				\$0
1. Materials and supplies				\$0
2. Publication costs/page charges				\$0
3. Consultant services				\$0
4. Computer (ADPE) services				\$0
5. Subcontracts				\$0
6. Other				\$0
Total other direct costs				\$0
H. Total direct costs (A through G)				\$46,356
I. Total indirect costs				\$0
J. Total direct and indirect costs (H+I)				\$46,356
K. Residual funds / Small business fee				
1. Residual funds (if for further support of current projects GPM 252 and 253)				\$0
2. Small business fee				\$0
L. Amount of this request (J) or (J - K1 + K2)				\$46,356
M. Cost sharing				\$46,356





**HOPE COLLEGE**

OFFICE OF THE PROVOST

July 24, 1996

Dr. Herbert Dershem  
Computer Science Department  
Hope College

Dear Herb:

Congratulations on the grant of \$46,356 which you, Mike Jipping, and Gord Stegink received from the National Science Foundation.

Best wishes to all three of you as you carry out your project, "An Integrated Classroom/Laboratory for Introducing Students to Object Oriented Concepts." I commend you for your collaborative efforts which you have under taken for the benefit of our students.

Again, Congratulations!

Sincerely,

Jacob E. Nyenhuis  
Provost

JEN:ey/jul96

pc: Dean James M. Gentile





# Hope College

## Department of Computer Science



### Memorandum

**To:** Jim Gentile

**From:** Herb Dershem *HD*

**Date:** January 7, 1997

**Subject:** ILI Classroom renovation plan

**CC:** Jon Huisken, Jerry Rademacker

COPY

The following is our budget and timetable for the computer science ILI renovation and equipping of VZN B24. We are submitting this for your approval and action.

#### *NSF ILI covered expenses*

12 Sun Ultra 1 computer systems	\$65,844
Graphics input tablet	\$900
12 Java Workshop software	\$2,400
12 SoftWindows software	\$3,540
LCD Monitor interface	\$11,500
3 Twisted Pair MiniHubs	\$675
Miscellaneous Cabling	\$1,000
Items yet unspecified	\$6,853

**Total ILI expenses**

**\$92,712**

#### *Expenses not covered by NSF ILI grant*

Air Conditioning for VZN B24	\$5,000
Floor height adjustment	\$1,500
Carpeting for VZN B24	\$2,500
12 Table units	\$10,000
24 Student chairs	\$6,000
Front table adjustments	\$5,000

**Total non-ILI expenses**

**\$30,000**

**Table 1: Timetable for project**

Date	Activity
Jan 97	Commitment from administration that room can be used for designated purpose Commitment from administration for \$30,000 required for renovation and furnishing VZN B24 Determine which of the present AV equipment in the room will remain there
Feb-Apr 97	Obtain the projector for the room through CIT Develop the software environment for the clab systems Commission and order the furniture for the clabroom
May 97	Renovation of the room (May 1 - May 31) Order workstations and software (May 1)
June-July 97	Install and test all hardware and software
August 97	Offer all computer science classes in the new clabroom (VZN B24)





## FINAL REPORT FOR AWARD # 9650129

Michael J Jipping ; *Hope College*

An Integrated Classroom/Laboratory for Introducing Students to Object Oriented Concepts

### Participant individuals:

CoPrincipal Investigator(s): Gordon A Stegink; Herbert L Dershem

### Participants' Detail

### Partner organizations:

#### Research Training:

Certainly, desk design and classroom layout are skills we developed. But, more importantly, we have gained experience in laboratory development, curriculum development, and pedagogical methods. We have new skills in the management of online materials and in effective Web page design.

Most importantly, we have developed skills in managing classrooms in such a way that students have increased learning and retention.

#### Education and Outreach:

We have (1) published results of our software development efforts (e.g., papers on JaDE), (2) demonstrated our classroom and how it works to other faculty, both on campus and off campus, (3) participated in panels at conferences about classroom design and the integration of laboratory and lecture-based experiences. We have given several presentation to the community in this new classroom, which has enabled us to teach the community better.

### Journal Publications:

#### Book(s) or other one-time publication(s):

#### Internet Dissemination:

<http://www.cs.hope.edu/csci120> <http://www.cs.hope.edu/csci225> <http://www.cs.hope.edu/csci352>  
<http://www.cs.hope.edu/jade/jade.html>

These are class Web sites that were developed for this room. Some are currently being taught but have an example of the material we developed.

### Other specific products:



## **Software (or netware)**

JaDE: A Web-based development environment for Java programs. This allows students to work on Java applets from anywhere on our campus, not just on a computer with a Java compiler.

THIS is an excellent teaching (in-class) tool as well as an environment for students developing code away from a Java Development Kit.

We have published a paper on this software, discussed it at conference panels, and made it available on the Internet.

## **Contributions:**

### **Contributions within Discipline:**

We have constructed a combination of a classroom and a laboratory environment. We have eliminated the separation between classroom and laboratory. We have demonstrated that this technique works to make learning and teaching better. We have shown that a combination of classroom and laboratory does indeed lead to new and innovative approaches to experiential, group learning.

We have succeeded in breaking barriers between faculty and student, between students, and between handicapped individuals and learning in the classroom.

### **Contributions to Other Disciplines:**

By demonstrating our innovative teaching approach, we have inspired others to redevelop classrooms and to teach using a combined classroom and laboratory approach.

### **Categories for which nothing is reported:**

**Participants:** Partner organizations

**Participants:** Other Collaborators

**Research Activities**

**Research Activities**

**Products:** Journal Publications

**Products:** Book or other one-time publication

**Contributions to Education and Human Resources**

**Contributions to Resources for Science and Technology**

**Contributions Beyond Science and Engineering**

Submit

Return



[View Activities PDF File](#)

[View Findings PDF File](#)



We welcome comments on this system



## Other Project Participants

**Stegink A Gordon** : CoPrincipal Investigator  
**Has worked for more than 160 hours** : Yes  
**Contribution to project** : No information.

**Dershem L Herbert** : CoPrincipal Investigator  
**Has worked for more than 160 hours** : Yes  
**Contribution to project** : No information.

[Return](#)



We welcome comments on this system



## **Major Findings**

Our major findings from this project were of two types: student learning and faculty teaching.

Student learning has improved. We surveyed students verbally and via forms. We found students believe they learn better in the new classroom/laboratory and are better able to retain information.

In terms of faculty teaching, we discovered that faculty were excited to teach in the new facilities and to revamp their classes to match. While curriculum restructuring is quite a bit of work, we saw direct benefits as we adapted classes to this new environment.

We have found small auxiliary benefits. We have virtually eliminated paper in most of the classes adapted for the lab (we still spend paper on examinations). We have increased our level of expertise -- both on behalf of faculty and students -- for Web page development. We have raised the level of sophistication with respect to student presentations. All these are ancilliary to our central findings, but are great side benefits.



## **Major Research and Education Activities**

Our major objectives for the project funded here were (1) merge lecture and laboratory into a single, unique classroom, and (2) develop course software and materials that will support this new classroom.

We built a classroom as specified in the grant proposal: new computers came from the grant funding, our college purchased desks and remodelled the classroom, we built an environment with computers embedded in desks arranged to facilitate group work. We developed software and installed procedures that facilitated this group work. We reworked the curricula of at least 6 different classes to fit the new teaching opportunities for this new classroom. At least 4 classes added in-class laboratory components to take advantage of the new classroom.

As an example, I point to JaDE, a Web-based software development environment that allows students to concentrate on fragments of Java code that illustrate key concepts. These fragments can be developed and discussed in class, with student experimentation via manipulation of the code. Compilation, error reporting, and code editing all take place through Web pages with no command line usage at all. Students are able to get started immediately and are able to concentrate on concepts rather than mechanics of code development.

The work done here has been presented to conferences and demonstrated for groups of professors.