Requests for Implementation Authorization must be submitted in a timely manner to receive approval by the Chief Academic Officers prior to submission to the Arizona Board of Regents for approval at a regular Board meeting. In each request, please provide the following information.

I. PROGRAM NAME AND DESCRIPTION AND CIF CODE*

A. DEGREE(S), DEPARTMENT AND COLLEGE AND CIF CODE

The Department of Linguistics in the College of Social and Behavioral Sciences at the University of Arizona wishes to establish a Master of Science degree in Human Language Technology (HLT).

This program has the Classification of Instructional Program (CIP) code #60.0199. No programs with this code are currently offered at the Arizona public universities.

B. PURPOSE AND NATURE OF PROGRAM

This Master of Science program is designed specifically to prepare students to enter a competitive scientific workforce. It will be a two-year program for students entering with background in linguistics and/or programming, and will provide coursework in the key areas of HLT including speech technology, stochastic language processing, language data structures, and business management. It will also offer internship opportunities in HLT in the state of Arizona and elsewhere. Students who complete the program will be able to get jobs on the cutting edge of information science and/or language-related technologies.

C. PROGRAM REQUIREMENTS — List the program requirements, including minimum number of credit hours, required courses, and any special requirements, including theses, internships, etc.

The minimum number of credit hours for this course is 36. The students are required to take the following courses: LING 438/538 (Computational Linguistics), LING 403/507 (Syntax), the HLT Business Course, LING 544 (Linguistic Typology), LING 515 (Phonemics), LING 419/519 (Statistics) (LIP), LING 669 (Advanced Computational Linguistics Seminar), and LING 378 (Speech Technology). In addition, the students are required to take 3-9 elective credit hours selected from the following courses: LING 301 (Formal Foundations of Linguistics), LING 504 (Advanced Syntactic Theory), LING 505 (Theories of Grammar), LING 510 (Foundations of Phonological Theory), LING 522 (Lexical Semantics), CS 620 (Advanced Topics in Neural Language Processing) or an appropriate course from departments such as MIS, CS or ECE by special arrangement.

The students will be required to do an HLT internship under the direction of one of the program’s industry affiliates and write a Master’s thesis including an actual working implementation.
D. CURRENT COURSES AND EXISTING PROGRAMS — List current course and existing university programs which will give strengths to the proposed program.

In the last few years, the Department of Linguistics has offered several HLT-related courses, including Language and Computers (388), Programming for Linguists (498/508), Speech Technology (478-578), Computational Linguistics (438/538), Linguistic Data Structures and Statistical Natural Language Processing seminars, and others.

Much of the architecture and resources necessary for the program are already in place. Specifically, we have courses, faculty, equipment, and library resources adequate to implement the program immediately. The linguistics department currently has five faculty members (Mike Hammond, Terry Langdorn, Noahso Waser, Sandiway Fong, and Sheila Dooley Gullberg) who are already teaching courses in HLT as part of the linguistics program. The department also has a phonetics laboratory with software for teaching speech synthesis and automatic speech recognition, and the College of Social and Behavioral Science Instructional Computing Lab is already serving as a teaching lab for HLT hands-on training in programming.

E. NEW COURSES NEEDED — List any new courses which must be added to initiate the program; include a catalog description for each of these courses.

LING 439/539 (Statistical NLP), one of the required courses for the program, is in the process of being approved at the moment and we anticipate it being in place by Fall 2005.

F. REQUIREMENTS FOR ACCREDITATION — Describe the requirements for accreditation if the program will seek to become accredited. Assess the eligibility of the proposed program for accreditation.

We are not seeking any type of accreditation so no special accreditation requirements will be necessary.

*Uniqueness is determined by means of CIP code. Please refer to the Board office the proposed CIP code for the new program before compiling this report. The Board of Innovation Board staff will provide a list of programs (if any) which share the same code. These guidelines should be used only for programs for which there is no duplication at another Arizona public university campus. For programs which share the same code as existing programs, please see the guidelines for duplication programs.

II. STUDENT LEARNING OUTCOMES AND ASSESSMENT

A. What are the intended student outcomes, describing what students should know, understand, and/or be able to do at the conclusion of this program of study?

This Master of Science program is designed to prepare students for entry into the workforce, with strength in language technology. The students will gain a strong
understanding of both linguistics and language technology. This knowledge will equip them with crucial skills, such as the ability to refine search engines and the ability to work on machine translation and speech recognition software.

B. Provide a plan for assessing intended student outcomes.

Student outcomes will be assessed in a variety of ways. Throughout their coursework, students will be expected to complete oral and written presentations of successful and robust course projects. As interns they will complete an original research project that must be written up and presented to a committee consisting of HLT faculty and internship sponsors. In workshops, students will also be expected to put together curriculum vitae and letters of interest consistent with industry standards.

The program’s success at producing students with the skills listed above may be evaluated as follows:

i. tracking students’ performance in coursework
ii. collecting and reviewing program evaluations from graduating students
iii. collecting and reviewing intern evaluations from industrial and research sponsors
iv. tracking job placement of graduates for at least two years after completion of the degree
v. tracking and comparing the number of HLT Master of Science degrees awarded annually

III. STATE’S NEED FOR THE PROGRAM


Industrial Demand

In Arizona and all over the US, the rapid growth of modern electronic communication, particularly the Internet, has greatly increased the demand for professional problem-solvers in the domains of information technology and information science. These are both facets of the Human Language Technology field, for information is most naturally "packaged" in spoken or written form in a human language. The demand for efficient information access and analysis requires a workforce with a deep understanding of both the nature of language and technology. The goal of the HLT program is to meet that industrial demand.

Possible local industrial internship sponsors for our HLT students include Lockheed Martin (Phoenix), Intel (Chandler), Raytheon (Tucson), and Motorola (Phoenix).

Internships with these partners should assure direct placement of graduates in the information science workforce upon completion of the degree.

Plans for the HLT program at the University of Arizona include development of an undergraduate introductory course. This extends the contribution of the program beyond the graduate level to reach students in the social sciences who might not otherwise be exposed to information technology. Such a course could greatly enhance the likelihood that these students will choose to pursue further studies in information technology at the University of Arizona, and would contribute to the creation of a technical workforce for the state.

B. IS THERE SUFFICIENT STUDENT DEMAND FOR THE PROGRAM? —Explain and please answer the following questions.
1. What is the anticipated student enrollment for this program? (Please utilize the following tabular format).

<table>
<thead>
<tr>
<th>5-YEAR PROJECTED ANNUAL ENROLLMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of New Student Majors</td>
</tr>
<tr>
<td>Total Student Majors</td>
</tr>
</tbody>
</table>

2. What is the local, regional and national need for this program? Provide evidence of the need for this program. Include an assessment of the employment opportunities for graduates of the program during the next three years.

Human Language Technology represents the fastest growing field of language research. Because of its industrial applications, it provides far more employment opportunities than are available within academia. The Master of Science degree in HLT is designed for students who are interested in going directly into industry, rather than going into academia on the PhD track.

3. Beginning with the first year in which degrees will be awarded, what is the anticipated number of degrees that will be awarded each year for the first five years? (Please utilize the following tabular format).

<table>
<thead>
<tr>
<th>5-YEAR PROJECTED ANNUAL NUMBER OF DEGREES AWARDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year:</td>
</tr>
<tr>
<td>No. Degrees</td>
</tr>
</tbody>
</table>

IV. APPROPRIATENESS FOR THE UNIVERSITY — Explain how the proposed program is consistent with the University mission and strategic direction statements of the university and why the university is the most appropriate location within the Arizona University System for the program.

The development of the Master of Science program in Human Language Technology meets with the University of Arizona’s determination to support programs of “focused excellence”. According to this directive, President Peter Likins asks us to accept the responsibility for greater self-sufficiency through entrepreneurship and the creative and aggressive pursuit of resources from many quarters to advance the UA as an enterprise. The goals be outlined include training graduate and professional students to be tomorrow’s leaders.

The Department of Linguistics at the University of Arizona is the appropriate administrative site for this program for two reasons. First, it already administers excellent
degree programs for the B.A., M.A. and Ph.D. degrees, including the M.A. program in Native American languages, which trains native speakers of the indigenous languages of North America for leadership positions in their own communities. Second, it has a core cadre of faculty members who are committed to its development, and who have already done a great deal of the initial work to set it up, including course development and program design. They accomplished this in part with support from TK2F Proposition 301 funding. A history of this funding is given in section VII.

V. EXISTING PROGRAMS AT OTHER CAMPUSES

A. EXISTING PROGRAMS IN ARIZONA——

1. For a unique (non-Duplicative) program, provide a statement to the effect that there are no existing programs at other Arizona public universities that duplicate the proposed program.

The HLT program is distinct from current offerings at the Arizona public universities.
No other programs offered by the Arizona public universities share the HLT program’s CIP code.

There is an Applied Linguistics PhD at Northern Arizona University with some departmental emphasis on research in corpus linguistics and computer assisted learning. These research areas do involve aspects of language and computation. However, that program is very restrictive in its foci, and it is not designed with the goal of preparing graduates to enter the Human Language Technology workforce.

An Artificial Intelligence research group is active at Arizona State University, primarily through their Department of Computer Science. Their foci include automated planning and manufacturing, as well as query optimization (http://www.cs.arizona.edu/voclas.html). Though related to HLT, the foci of this group are also much more restrictive than our proposed HLT program.

To our knowledge, the language and technology efforts mentioned above only represent potential research areas at NAU and ASU. They are not official, distinct, AOCR-approved Human Language Technology degree programs.

2. Other Institutions — If this program is not currently offered at the same academic level by private institutions in the state of Arizona, provide a statement to that effect. If a similar program is currently offered by private institutions, list all programs and indicate whether the institution and the program are accredited. (A list of institutions will be provided by Board staff. Please utilize the following tabular format and contact Board staff for assistance, if needed).

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>PRIVATE INSTITUTION</th>
<th>NCA Accreditation? (Y or N)</th>
<th>Program Accreditation? (Y or N)</th>
</tr>
</thead>
</table>
To the best of our knowledge, there are no other accredited programs offered at this level in the State of Arizona.

B. PROGRAMS OFFERED IN OTHER WICHE STATES

1. Identify WICHE institutions that currently offer this program. If appropriate, briefly describe the program. (Please use the following format).

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>WICHE INSTITUTION &amp; LOCATION</th>
<th>NCA Accreditation? (Y or N)</th>
<th>Program Accreditation? (Y or N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MS in Computational Linguistics</td>
<td>University of Southern California, Los Angeles, CA</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2 MS in Computer Science and Electrical and Computer Engineering with linguistic emphasis</td>
<td>The Oregon Graduate Institute of Science and Technology Portland, OR</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>3 MA in Computational Linguistics</td>
<td>University of New Mexico, Albuquerque, NM</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>4 MA in Computational Linguistics</td>
<td>University of Washington Seattle, WA</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>5 MA in Computational Linguistics</td>
<td>San Diego State University, San Diego, CA</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>6 Interdisciplinary Certificate in HL T</td>
<td>University of Colorado, Boulder, CO</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

To the best of our knowledge, this is an exhaustive list of programs which are the same as or similar to our HL T program. Only the University of Southern California (item 1) offers an MS in Computational Linguistics. The Oregon Graduate Institute MS (item 2) is a degree in Computer Science and Engineering or Electrical and Computer Engineering, where the student has the option of focusing on linguistic domains. The University of New Mexico, the University of Washington, and San Diego State University (items 3-5) offer MA degrees, not MS degrees. The University of Colorado (item 6) offers only a certificate, not a degree.

VI. EXPECTED FACULTY AND RESOURCE REQUIREMENTS

A. FACULTY

1. Current Faculty -- List the name, rank, highest degree and estimate of the level of involvement of all current faculty who will participate in the program. If proposed program is at the graduate level, also list the number of master's theses and doctoral
dissertations each of these faculty has directed to completion. Attach a brief vita for each faculty member listed.

- Sheila Dooley Colberg, PhD, is a specialist in linguistic typology and generative syntactic theories, with background in computational linguistics from work on machine translation in the SWETRA project at Lund University, Sweden. She developed the LING 388 (Language and Computers) course under previous TRIP 201 grants and taught the course prior to the hire of Fong. She is now the acting coordinator for the HLT MS program.

- Sandyway Fong, PhD, is an Associate Professor in the Department of Linguistics at the University of Arizona. He will be a professor in the HLT program and will teach LING 538 (Computational Linguistics) and LING 699G (Advanced Computational Linguistics Seminar). Because he only recently joined the staff, he has not directed any Master’s theses or PhD dissertations to completion.

- Michael Hammond, PhD, is a Professor in the Department of Linguistics at the University of Arizona. He will be a professor in the HLT program and will teach LING 508 (Computational Techniques for Linguists) and LING 498/539 (Statistical NLP). He has directed 10 Master’s theses to completion and 14 PhD dissertations to completion.

- Terry Langendoen, PhD, is a Professor in the Department of Linguistics at the University of Arizona. He will be a professor in the HLT program and will teach LING 538 (Computational Linguistics) and LING 501 (Formal Foundations of Linguistics), as well as LING 699G (Advanced Computational Linguistics Seminar). He has directed 5 Master’s theses to completion and 16 PhD dissertations to completion.

- Natasha Warner, PhD, is an Assistant Professor in the Department of Linguistics at the University of Arizona. She will be a professor in the HLT program and will teach LING 478/578 (Speech Technology). She has directed 5 Master’s theses to completion and 2 PhD dissertations to completion.

- Andrew Wedel, PhD, is an Assistant Professor in the Department of Linguistics at the University of Arizona. He will be participating in the HLT program as an adviser for students working on projects outside the standard curriculum and will teach LING 408/508 (Computational Techniques for Linguistics). Because he only recently joined the staff, he has not directed any Master’s theses or PhD dissertations to completion.

2. Additional Faculty -- Describe the additional faculty needed during the next three years for the initiation of the program and list the anticipated schedule for addition of these faculty.

We will be adding one additional faculty member with expertise in HLT. Ying Lin. He will be an Assistant Professor in Linguistics and a professor in the HLT program. He will teach LING 490/539 (Statistical NLP) and LING 478/578 (Speech Technology), and will take up teaching duties in Fall 2005. After this hire, no new faculty will be required in the next three years.

3. Current FTE Students and Faculty -- Give the present numbers of FTE students and FTE faculty in the department or unit in which the program will be offered.

CURRENT FTE STUDENTS AND FACULTY
<table>
<thead>
<tr>
<th>FTE Teaching Faculty</th>
<th>FTE Graduate Assistants/Associates (Research and Teaching)</th>
<th>FTE Staff</th>
<th>FTE Appointed Personnel (Research Associate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.5</td>
<td>11.5</td>
<td>3.5</td>
<td>1.0</td>
</tr>
</tbody>
</table>

4. Projected FTE Students and Faculty -- Give the proposed number of FTE students and FTE faculty for the next three years in the department or unit in which the program will be offered.

<table>
<thead>
<tr>
<th>YEAR PROJECTED ANNUAL ENROLLMENT</th>
<th>1st yr.</th>
<th>2nd yr.</th>
<th>3rd yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTE Teaching Faculty</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>FTE Graduate Assistants/Associates</td>
<td>16.5</td>
<td>21.4</td>
<td>21.5</td>
</tr>
<tr>
<td>FTE Staff</td>
<td>3.5</td>
<td>4.6</td>
<td>4.5</td>
</tr>
<tr>
<td>FTE Appointed Personnel</td>
<td>1.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

This table represents departmental numbers as a whole, but growth shown includes only that from the HLT program.

B. LIBRARY

1. Current Relevant Holdings -- Describe the current library holdings relevant to the proposed program and assess the adequacy of these holdings.

The Library has been steadily building its collections in computational linguistics, acquiring key new journals and monographs in the main library and in the science engineering library. The Library has been a member of the Linguistic Data Consortium for five years, and we have over 130 data sets in our collections now. What we do not own in print or have electronic access to, we acquire for faculty and students via interlibrary loan, delivering journal articles to the researcher's desktop in 1 to 3 days at no charge.

2. Additional Acquisitions Needed -- Describe additional library acquisitions needed during the next three years for the successful initiation of the program.

The library has assured us that they will continue book purchases and journal subscriptions related to the field of HLT.
C. PHYSICAL FACILITIES AND EQUIPMENT

1. Existing Physical Facilities -- Assess the adequacy of the existing physical facilities and equipment available to the proposed program. Include special classrooms, laboratories, physical equipment, computer facilities, etc.

All necessary equipment and space will be ready for HLT students in Fall, 2005. The HLT lab will accommodate 10-13 students and includes laptops with the latest software necessary for HLT work.

2. Additional Facilities Required or Anticipated -- Describe physical facilities and equipment that will be required or are anticipated during the next three years for the proposed program.

The HLT lab will need refreshing during the next three years. Increased student activity should generate increased grant funding, which will be used for later lab refreshing.

D. OTHER SUPPORT

1. Other Support Now Available -- Include support staff, university and non-university assistance.

In terms of personnel, the current Linguistics department staff and faculty will also be involved in the HLT program. In terms of funding, we have a grant from the Ford Foundation and from TRIP. For details, see section VII A.

2. Other Support Needed, Next Three Years -- List additional staff needed and other assistance needed for the next three years.

Over the next three years we will need to add new staff members for the additional administrative support required by the addition of students to the department. This is reflected in the attached budget proposal. (Dean Domonkoski has committed to helping us locate funds for this purpose and it will not be necessary to go to 381 for central administration for this.)

VII. FINANCING

A. SUPPORTING FUNDS FROM OUTSIDE SOURCES -- List.

We received a $5,500.00 Ford Foundation planning grant in Spring 2004. These funds will be used for preparation of recruitment materials and expenses for the establishment of connections with potential industrial advisors.
<table>
<thead>
<tr>
<th>FY 01-02</th>
<th>Langendoen</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15,976</td>
<td>wages</td>
</tr>
<tr>
<td>Awarded February 2002</td>
<td>3,250</td>
<td>Operations</td>
</tr>
<tr>
<td>Encumbered by 7/01/02, spent by 12/31/02</td>
<td>20,416</td>
<td></td>
</tr>
<tr>
<td>Awarded August 2002</td>
<td>4,006</td>
<td>Operations</td>
</tr>
<tr>
<td>Encumbered by 7/01/03, spent by 12/31/03</td>
<td>5,400</td>
<td></td>
</tr>
</tbody>
</table>
B. NEW ACADEMIC DEGREE PROGRAM BUDGET

PROJECTIONS FORM — Complete the appropriate budget form, available at [http://www1.msu.edu/auwd/SSCCForms.html](http://www1.msu.edu/auwd/SSCCForms.html) describing the current departmental budget and estimating additional costs for the first three years of operation for the proposed program. Please note that these costs for each year are incremental costs, not cumulative costs.

As noted above, most of the infrastructure required for this degree is already in place in the Linguistics Department. The attached budget reflects these additional costs for the first 3 years of running the program:

- One new 5 staff member added in Year 1 for administrative support (College has committed to backstopping this; see above.)
- Courseload reduction for the Coordinator (1 course per year; College has agreed to cover this.)
- Small increase in operations budget ($1,000 per year. College has agreed to work with us to locate funds; we will not need to go to 301 or central administration for this.)

VIII. OTHER RELEVANT INFORMATION

ADDITIONAL INSTRUCTIONS FOR HOW TO FORMAT THE REPORT

- In order to ensure consistency headings and bolding should follow the format of this guideline. Leave a one-inch margin at the top so that the Board office can paginate all documents.