

Departmental Honors in Computer Science: 2012 Revision

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1 TL;DR

This proposal:

- Changes the minimum overall GPA requirement from 3.0 to 3.25. (The CS GPA requirement of 3.5 is unchanged, but is now specified to exclude non-major courses.)
- Adds a requirement that honors students complete an oral defense, as recommended by university policy.
- Adds the following coursework requirements, to approach a 12-credit minimum recommended by university policy:
 - Adds a requirement that honors students take two (to be created) 300- or 400-level honors “H-version” courses, ad-hoc “honors option” extensions to 400-level classes, or graduate courses, totaling 6 credits.
 - Adds a requirement that students take 396H, a revision of 297, which will remain 1 credit.
 - Adds a requirement that honors students take 3 credits of 499.
- Codifies miscellaneous policies:
 - Individually-written thesis will be required.
 - H-version courses are also open to students with 3.5 CS/3.5 overall GPA.
 - Expected features of a 400-level H-version.
 - A timeline for phase-in of new requirements.
 - BS/MS students must complete honors thesis before finishing BS.

2 Goals and Metrics

The intent of this design of the honors program is to:

1. Increase the number of students involved in undergraduate research. Quantified by 499 enrollment, possibly undergraduate paper authorship.
2. Provide an attractive honors program for recruiting bright high school students.
3. Increase the number of undergraduates who pursue graduate study. Quantified by exit data about honors students at graduation.

4. Facilitate getting our graduate-school-bound students three high-quality letters, with less reliance on lecturers.
5. Normalize our program in the context of university honors, which expects 6 credits of coursework, 6 credits of research, thesis, and oral defense.
6. Provide competitive nominees for the CRA Outstanding Undergraduate award and applicants to the NSF Graduate Research Fellowship by involving students in research projects as juniors or earlier.
7. Maintain or increase the diversity of the honors program.
8. Build a community of students participating in the departmental honors program. Quantified by participation in (new) honors events (e.g., National Cryptologic Museum visit, picnic).
9. Encourage students to take advantage of Honors College and CMNS activities. (see <http://www.honors.umd.edu/departmentalhonors.php> online).

3 What are the university standards for honors?

The university guidelines for an honors program include (quoting, emphasis mine):

Curriculum: Two options have been approved. Departments need not offer both, but the thesis option should always be made available to interested students.

Thesis Option: **12 credit minimum**

1. **At least two upper-division (numbered 300 or above) Honors courses**, seminars or workshops in the major department or college or (with the permission of the department) in any department on campus. **Graduate courses (numbered 600 or above) in the major may be substituted** for all or part of this requirement.

2. **At least 6 credits of research and thesis writing** under the direction of a regular College Park faculty member, **followed by an oral defense of the thesis before two or more faculty members.**

Non-thesis Option: 12 credit minimum

1. **At least four upper-division Honors courses** or seminars taken in the department or college or, with permission, any department on campus. Graduate courses may be substituted for all or part of this requirement.

2. **A three-hour written comprehensive examination** in the major field, evaluated by at least two faculty members in the department or college.

4 How are those standards applied?

Not every department follows these guidelines. Below, I've summarized the requirements of some departments: those that are also in science or engineering and some others for comparison. Few have a non-thesis option as specified by the university: ECE is closest by having honors courses, but substitutes a Senior Honors Project for a comprehensive exam. Atmospheric and Oceanic Science has an "Honors Oral Examination" but describes no research requirement.

Department	Credits					GPA		Notes
	Seminars	Courses	Research	Thesis	Defense	Major	Overall	
Atmospheric	-	6	-	-	Y	3.3	3.0	Two grad courses
Biology	4	-	3	Y	Y	-	3.0	Seminar every semester
CS	-	-	-	Y	-	3.5	3.0	297 optional.
CellBio	3	-	6	Y	Y	-	3.25	Advisor letter first
Chemistry	-	-	6	Y	Y	-	3.0	Research before admission.
Criminal Justice	3	3	6	Y	Y	3.4	3.25	"Meeting all requirements does not guarantee admission"
ECE	-	12	3	-	-	-	3.0	Honors sections of many 300-level classes.
Economics	-	6	6	Y	-	3.25	3.25	
Engineering	2	-	3	Y	Y	-	-	Top quarter of GPA required
English	6	-	6	Y	Y	-	-	
Geology	3	6	6	Y	-	3.0	3.0	Grad or honors option courses.
Kinesiology	-	12	6	Y	Y	3.5	3.5	High honors for 3.7 GPA and outstanding thesis
Math	-	6	6	Y	Y	3.3	3.0	Also non-thesis option with 12 course credits.
Physics	-	3	3	Y	Y	3.3	3.0	Thesis for high honors, Grad course can replace defense
Psychology	6	-	6	Y	Y	3.3	3.3	High honors for 3.7 GPA and exceptional thesis

Table 1: Summary of honors program requirements in science and engineering, and large departments. Department names are clickable for the details.

5 Proposed Program Requirements

Students in the “new” honors program will be required to:

- Enter the honors program no sooner than completion of 216 and 250, with a CS GPA of 3.5 and overall GPA of 3.25. (Section 8).
- Take at least one instance of a 1-credit 396H, which replaces 297. (Section 6.1).
- Take two honors (Section 6.2) or graduate courses. At most one may be a 300-level honors course (330H or 351H, if offered). At most one may be an honors option course. (Section 6.3). 800-level graduate courses may be used only if they are PhD Qualifying courses.
- Take at least one instance of 499 (independent research) or 390 (honors independent research). (499 is more useful toward graduation requirements.)
- Complete a thesis to be edited and approved by a committee of at least two faculty: the advisor and another faculty member. (Section 7)
- Defend the thesis at an oral defense, held at least four weeks before the end of the semester of graduation. The oral defense would not have a closed-questioning component; attendance by other honors students would be encouraged.

These requirements should not typically extend the time to graduation. The 499 independent study course counts as a 4xx elective, 396H counts as 1 of three credits of upper-level elective. Graduate and honors 300- and 400-level courses count toward breadth requirements. Graduation requirements are at <http://undergrad.cs.umd.edu/degree-requirements-cs-major>.

Substitutions in these requirements are likely to be granted by petition to the honors chairs. For example, a second 300-level honors course may be substituted for 396H for students with schedule conflicts. Scheduling conflicts are to be expected, especially because over half of our honors students are double majors. A structured research experience such as an REU could be substituted for a 499. A presentation at a conference could be substituted for an oral defense.

Exceptions to the course or GPA requirements may be requested by petition to the honors chairs, but should not be the norm.

6 Courses

6.1 Redesign of 297 to 396H

The 297 seminar is currently open to any student who expresses interest, regardless of GPA or standing. It is also not required of honors students. Finally, it is a one-credit Satisfactory/Fail-graded class that does not permit assigning substantial work. This limits the potential for community building activities within the class and the honors program.

Students in 297 currently listen to lectures from various faculty or prior honors students and write an essay.

The new 396H will be a 1-credit course.

A typical outline for the class is as follows. The first 8 weeks will consist of faculty and graduate-student-led presentations of recent research papers and proposed work, not unlike 297. Students will be required to read research papers before class, and write reviews of a subset of those papers. The goal of this section is to develop the ability of honors students to read research papers in general and determine which areas are interesting to them.

The final 7 weeks will consist of group work in more specific areas, mentored by faculty in those areas. The goal of this section is to give honors students research skills sufficient to start

working constructively with faculty immediately. In a discussion with the chair, theory, systems, programming languages, and hci were raised as likely areas that could supply a faculty mentor, though the specific areas may depend on faculty mentor availability and student interest. In class, students would learn research techniques and tools (latex, gnuplot, jgraph, graphviz, tgif) that may apply to their projects. Groups will present their projects and prepare short reports.

To include a project requires changing the grading type, and to match departmental honors program requirements, requires renumbering the course to the 300-level, 396H. 396H would include 216 and 250 as prerequisites, and follow the policy below (Sec 6.2.2) of being open even to high-GPA students who are not enrolled in the honors program. (We may consider lowering the high-GPA threshold for this class from 3.5 to 3.25, in case it may awaken a student's interest.)

6.2 Honors sections “H-versions” at 300 and 400 level

Honors sections may be added for 330, 351, and 414,¹ and consider splitting other high-demand courses into H-version and normal sections for one semester each year. Candidates might include:

- 456 - Cryptology, with the advantage that it is security related, but a complicating factor that it is cross listed with math and taught by CS only in the fall.
- 417 - Networking, which is being taught by two faculty fall 2012.
- 421 - Artificial Intelligence, which is being taught by two faculty fall 2012.
- 424 - Databases, which was taught by two faculty spring 2012.
- 434 - HCI, which was taught by two faculty spring 2012. (but not offered in fall 2012.)

The ability to offer honors sections of other courses will depend on resources; ideally, every area would have the opportunity to offer an honors course, however, honors option courses and graduate courses could fill this niche for students.

I expect we would offer 330H in fall and 351H in the spring, to limit the workload and encourage students to take both. However, students may take these courses concurrently in order to get quickly to the 400 level, so they may best be taught every semester.

6.2.1 Features of an Honors 400

Specific content to be added to honors sections would be up to the field committee or instructor, but could include the following in roughly decreasing order of importance. Examples from hypothetical 412H or 417H are included.

- An overview of department research opportunities in the area, possibly near the end of the semester.
- Projects that extend or complement recent local research, e.g., a strategic BitTorrent client or distributed file system.
- Occasional use of primary source material, e.g., original research papers for congestion control, Chord, path MTU discovery, RAID, log structured file system, Google file system, Ken Thompson's turing lecture, etc.
- Projects that build upon prior projects, with the expectation that students will complete intermediate milestones without falling behind, to permit students to build “cool,” complete things.

¹As of writing, there are 40 students enrolled in 414 plus 20 on a wait-list; it is our most oversubscribed class on testudo.

- Open ended exam questions that encourage creativity and synthesis over recall.
- Guest lectures for of-the-moment content, e.g., to describe the latest security failure (Sony Playstation passwords), wireless technology (LTE?), or programming language (Dart?).
- A report-writing component. A smaller class size may enable writing assignments that otherwise do not scale well.
- Projects that are less well specified or are trial projects for wider adoption, with the expectation that students may be more patient and helpful as testers.
- Honors courses must be taught in separate classroom, specifically, not code-shared with graduate courses. Students may take graduate courses if they wish.

6.2.2 Eligibility for H-version Courses

Students must be in good standing in the departmental honors program, or have 3.5 major and 3.5 overall GPA, be in another university level honors program, or by permission.

Priority should be given to students in the honors program.²

Graduate students should not register for honors sections.

CE majors meeting the GPA requirement may take H versions, including H-versions of required courses 216H, 330H, 351H or 412H, or technical electives.

The motivation for this requirement (honors program or high GPA) is primarily to encourage students who have an interest in a specific area to study just a bit deeper in their area of interest. These students may at first be more interested in a specific area than in research in general, and may become interested in research in that area as a result. In addition, the full honors program will have to remain too small to fill honors sections, since each faculty member can advise only so many undergraduates. An honors course in an area may provide students with special expertise that will help them in seeking employment in that area.

6.2.3 Policies associated with an honors section

Can a student transfer between the honors section and the non-honors section? Students are can leave the honors section during the add/drop period, adding the non-honors class. Students may enter the honors section before the third class meeting; this restriction will be enforced by stamps.

H and non-H coursework may share little in common, meaning that any graded work would not transfer between sections.

Will taking an honors course hurt a student's GPA? It could. Honors students are accustomed to earning A's, and it is reasonable to expect that the distribution of grades in an honors course will be higher than it is in a non-honors section. However, the honors class will require these good students to spend more time on the class, perhaps as much time and effort as less prepared students need when completing assignments in non-honors classes. Students who run out of time, or struggle with the material may well earn lower grades than they expect.

Are honors program students guaranteed a spot in an H-version of their choice? No. The university sets registration order in descending order of how many credits a student has earned, meaning that junior students will not have priority.

Is there an enrollment limit to an H-version? Practically, 15 students may be required to justify the class, 40 students would be the maximum enrollment.³

²Giving priority to honors-program students may not be technically possible.

³Whether these are practical limits is unclear. ECE runs H-versions with as few as 5 students and as many as 25.

6.3 Honors option courses

In the university honors program, students can add to an existing course to create an “honors option” course, which can then substitute for an honors class in the requirements. So, rather than take an existing honors class in an uninteresting area, students could augment a class more in their interest.

There is a procedure, consisting of a proposal that must be approved by the honors college, submitted by the tenth day of class. See the honors college page for detail: http://www.honors.umd.edu/honors_option.php. This might be a nice approach for students who are interested in an area but not prepared for the graduate version of a class.

“Honors option” treatment should be available only to 400-level courses, i.e., not 330 or 351.

7 Research: Honors Thesis and Oral Defense

Two faculty are required to approve an honors thesis and administer an oral exam. Honors committee members would be typical choices for a second member. The entirety of the honors oral defense will be public, in contrast to Ph.D. exams which include closed questions and closed discussion components.

We will schedule oral defenses on an ad hoc basis. (Some departments arrange for all oral defenses to be held on the same day.) Oral defenses must occur at least four weeks before the end of the semester in which the student will graduate, in order to ensure degrees include the honors annotation.

Existing research group meeting time slots may be used. Students may also defend in a late-semester 396H class meeting.

The thesis shall be presented to the honors chair and to the committee two weeks (or more) before the oral defense. (And thus six weeks before the end of the semester.) The thesis should be formatted using the ACM sig-alternate style, though exceptions may be made. It should be between 4 and 10 pages long in this format, though longer is reasonable especially for figures.

It should include:

- A statement of the *problem* being solved and its importance.
- A description of the faults of *prior approaches*.
- A description of the *insight* that solves the problem in a new way or shows that the problem can be solved.
- Sufficient *technical contribution* to warrant an honors thesis.
- A conclusion section that restates the main contributions of the thesis and presents *future work*.
- At least five *references*.

The presentation shall address the following topics, likely via slides entitled:

- Problem
- Related Work
- Thesis (or Insight)
- Contributions
- Future Work
- Acknowledgements

These requirements leave implicit area-specific requirements that may include: performance graphs, lemmas, architecture diagrams, proofs, comparison tables, and demonstrations.

7.1 Individual work

A student's honors thesis must be the student's own work, not a collaborative group project with other students. Only collaborators who act in an advisory capacity (providing edits, feedback, direction, suggestions, etc.) may be listed as coauthors.

The key ideas in the honors thesis should be largely the student's own. The problem may be specified by an advisor, and the methods to try may be chosen by others. However, the bulk of the intellectual work to evaluate the ideas should be the student's own.

Group project reports may not serve as honors theses. (Gemstone, QUEST, DCC, and other University programs create group projects.) However, a student may write up an individual contribution to a larger project, if that component is advised by CS faculty.

Group project documents, e.g., multi-author conference papers, are not allowed. Students participating in such a project may write up their contributions as a separate, complete thesis document. The <http://www.cs.umd.edu/Honors/joint-work.html> form and one or two page description of individual contribution will no longer be used.

Incomplete documents will be rejected, whether caught by advisors or by the honors chair. For example, clear TODO items such as "(guys provide the SQL query used and results e.g. empty dataset)", "TBA", or "TODO" should not be found.

8 Our 3.5 CS/3.0 GPA requirement was relatively high: too high?

8.1 Brief CS GPA Analysis

I looked at the GPAs of students who have taken independent research (499) and graduate classes (600-700), expecting to find a spike in the distribution to quantitatively tell us whether the honors program requirement of a 3.5 major GPA was too selective in practice. Other departments use 3.0's or 3.3's, and my hunch was that faculty do in fact work with students having GPAs below 3.5, but not below, say, 3.0. It's not as clear cut as I'd hoped, but:

- 90% of students who take graduate courses have undergrad CS GPAs above 3.1. Students with a lower CS GPA have a less than 50% chance of getting an A in their first grad class. (Implies 3.5 is too high)
- Students who take 499 are somewhat more likely to have CS GPAs between 3.0 and 4.0 than students in, say, 420 or 451. However, there are many students with lower GPAs. Some lower-GPA students are capable but don't take grades seriously. Other lower-GPA students are taking 499 as a path toward graduation. Faculty are generous with their time, or selective by something other than student GPA. (Inconclusive)
- There are small spikes in the distribution of GPAs of students who sign up for 499 at around 3.3 and 3.75. Nothing too significant. The median CS GPA when registering for 499 is 3.2, which is higher than that of 451 (3.1) and 420 (2.9). (Implies 3.5 is too high)
- Students who took 499 and are now in our grad program had CS GPAs of 3.1, 3.2, 3.4, and 3.6. (Implies 3.5 is too high.)
- Students who take 451 are generally only able to get an A if they have a 3.4 to begin with. (90% of A's go to the 40% of students with GPA at or above 3.4.) (Implies there is a discontinuity in performance around 3.4.)

8.2 Proposed GPA requirement

I propose to make the new GPA requirement be 3.5 in CS and 3.25 overall. This maintains the CS GPA and raises the overall GPA.

For CS GPA computation, courses that do not count toward the major are not included, e.g., CMSC 100 and CMSC198. The overall GPA is as computed by the university. Despite the different grading distribution, graduate courses will count.

8.3 As applied to current honors students

There are 24 current students who are members of the honors program. At some point, these students signed up, vouching for their GPAs by email. Of these 24, 13 meet the current GPA requirement of 3.5 CS and 3.0 overall. Only two additional students of the 24 would meet a lower 3.3/3.25 requirement, one of whom is interested in completing a project, the other is very close to graduation and unlikely to.

8.4 GPA Distributions of students enrolled for Fall 330

Students currently enrolled in 330 are just past the 216/250 prerequisite for admission to honors. Considering their GPAs tells us how many students are eligible for the program by three GPA thresholds: CS GPAs (a) with and (b) without +/- consideration and (c) the overall GPA as computed by the university. The estimate of the “new” GPAs assumes that grades do not change with the introduction of +/- grading, in particular, that B’s don’t turn into B+’s, and the main effect is that the top end of GPA’s is reduced somewhat because of A-’s.

GPA	Percentage of majors registered for 330		
	CS old	CS new (+/-)	Overall old
≥ 3.0	58%	53%	57%
≥ 3.25	43%	37%	46%
≥ 3.3	37%	36%	44%
≥ 3.4	33%	33%	36%
≥ 3.5	33%	29%	30%
≥ 3.75	21%	21%	18%

Table 2: Percentage of 172 CS majors entering fall or taking summer 330 who have GPAs above potential thresholds for admission to departmental honors. “CS old” counts only major-requirement CS classes using the existing method of integer grade points. “CS new” considers +/- grades as counting, to estimate what fraction of students will have a given GPA one or two years from now. “Overall” is the GPA as computed by the university. (I do not have sufficient access to compute an “Overall new”).

To have approximately the same fraction of eligible students after the change of GPA computation method requires reducing the CS threshold to 3.4.

To ensure that departmental honors students do well in their other coursework, raising the overall threshold to 3.25 appears safe. In fact, it excludes no additional students from among the sample enrolled in 330. That is, all CS majors with CS GPA above 3.3 by either new or old method also have overall GPA’s outside the range 3.0 to 3.25.

9 Target Program Size

The target size of the honors program is 50 students, 25 new honors students per year. This doubles the size of the current honors enrollment (24 students, though fewer have adequate GPA), and adds 25% over the number of students who complete 499s.

Using the eligibility for honors courses criterion of 3.5/3.5 GPA from section 6.2.2, we can expect more than 1/4 of our students to be eligible. The incoming class has 150 students, so 37 students per year.

For comparison the target size for ACES is “roughly 45 freshmen each year.”⁴

Honors “events” or other activities explicitly for honors students might be best approximated by the number of students taking 499s. Over four semesters, approximately 40 students complete 499s.

Class	Spring 2011	Fall 2011	Spring 2012	Fall 2012
131H	-	22	-	22
132H	21	25	15	25+1
250H	29	-	25	-
297	-	16	-	13

Table 3: Class sizes of current H-version offerings and 297, from testudo. Fall 2012 132H has a waitlist of one student.

Class	Spring 2011	Fall 2011	Spring 2012	Fall 2012
303H	-	14	-	20
313H	7	-	6	-
322H	-	17	-	19
324H	18	-	11	-
350H	-	11	-	25
380H	-	16	-	5
381H	9	-	9	-

Table 4: For comparison, ECE’s honors classes. EE honors students must take four; some courses are not part of the computer engineering degree.

10 Interactions

10.1 BS/MS Program

The requirements of current honors (a thesis) and future honors (a thesis plus honors or graduate coursework) are similar to BS/MS requirements and overlap.

Honors Thesis vs. Master’s Thesis Students admitted to the BS/MS program must submit an honors thesis and complete the oral defense before completing *six* 400+-level courses. (400+-level includes the 499 and any graduate classes taken.) Students still graduate “with honors” at the end of their BS program.

⁴http://www.washingtonpost.com/business/capitalbusiness/university-of-maryland-northrop-grumman-partner-on-cybersecurity-2012/06/09/gJQA7DaFUV_story.html

A master's thesis should include substantially more content than an honors thesis. By completing the honors thesis early, there will be time for substantial further development to the idea or a completely different project.

This "before-six-400" requirement does not apply to students who are not in the BS/MS program, who may complete their requirements at any time before graduation.

It is the responsibility of the Master's thesis advisor to determine that substantial additional work was completed. Since BS/MS students must complete 6 credits of 799, the Master's thesis should easily have much greater scope than the Honors thesis.

Courses Should a student satisfy the honors course requirement using a graduate class, that class may also "count" toward the MS, with no additional limitation created by having the class satisfy honors requirements.

10.2 Transition

This section addresses the requirements for students currently in the Honors program or who will begin before courses are in place, which may occur in Fall 2013.

Students may use (the discontinued) 297 in lieu of 396H.

Until there is an H-version course offered every semester, only one honors (H-version, honors option, or graduate) course shall be required. That is, students entering the honors program after adoption of this proposal, but before Fall 2013 shall be required to take only one advanced class.

Students who apply to the honors program in calendar 2012 may complete honors using old or new program requirements. Beginning in calendar 2013, only the new program will be available.

Restrictions on individual work, honors thesis formatting, and the requirement of a structured research experience (REU or 499) apply immediately.

Students who sign up for the honors program, then lose eligibility by GPA may re-enroll, with the requirements in effect at the time of re-enrollment.

11 "High" Honors

We will continue to use the nomination of the advisor and the caveat "High Honors are rarely given; the advisor's recommendation is necessary but not sufficient, and the honors director(s) make the final decision. In the rare cases that it has happened in the past, the student has done TWO honors projects or ONE that gets into a refereed conference or journal."

12 Beginning of Semester Announcement

The following message will be sent to the faculty@cs mailing list each semester.

Undergraduate Research

Please invite talented undergraduates to participate in research. Consider inviting students to attend research group seminars, reminding them to attend distinguished lectures, or meeting directly to talk about research interests. The honors chairs and undergraduate advisors can help place students if their interests are different from yours.

REU Funding

If you're advising undergraduates, consider submitting an REU supplement request on an existing NSF grant. NSF guidelines are at <http://www.nsf.gov/crssprgm/reu/faculty.jsp> . Ask if you would like to see a sample supplemental funding request.

Honors

Undergraduates are eligible for departmental honors by taking honors or graduate coursework, completing an honors thesis, and maintaining a 3.5 GPA in CS. Undergraduate students, particularly those taking 499's or hired as RA's, are likely to be eligible.

Honors Deadlines

For a student graduating this semester, the honors thesis must be turned in by (End-6weeks), and defended by (End-4weeks). Extensions are possible but may result in missing an honors designation on transcript and degree.

Honors “option” courses

If you are willing to allow students to complete your 400-level course as an honors option, please consider noting in your syllabus:

Honors students: If you would like to complete a substantial additional project in this class so that the class counts towards your honors coursework as an “honors option” course, please contact me this week so that we may discuss a unique project and submit the honors option proposal.

The proposal must be submitted to the honors college by the tenth day of class. See: http://www.honors.umd.edu/honors_option.php.

NSF Grad Research Fellowship Deadline

November 13, 2012. See: <http://www.nsfgrfp.org>. Seniors applying for graduate school and first-year graduate students are eligible.