Annual Assessment and Program Review Report

Westmont College Computer Science Program

September 15, 2009

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I. Mission Statement and Learning Outcomes

I.1. Computer Science Program Mission Statement

During the past year, we have reflected on our purpose, which has lead to the following statement: we desire to transform our program into one that efficiently and sustainably pumps students up to their full potential in computer science. We have not changed our detailed vision statement for the program. As included in our 2008 report, our vision continues to be stated as follows.

Core Values: Who We Are
Like many excellent and rigorous computer science programs around the world, we emphasize the fundamental and theoretical foundations of computation. At the same time, we ground the formal concepts in current advances in technology. Many aspects of the field are constantly changing, and staying current with new developments is a significant challenge. We believe that the best way to enable graduates to efficiently stay on top of the field is to lay a solid foundation of the fundamentals on which constant changes are ultimately based. We believe that the best way for us as faculty to remain current in the field is to conduct research and contribute to the field of computer science in our respective areas of emphasis. The formal foundation we lay serves our students well in their continued education in graduate school. For those who choose to enter the workforce immediately, this foundation equips them to be among the more versatile thinkers, learners and developers of their peers.

A number of schools provide similar rigor in their CS programs, yet two core values help set Westmont apart from other similar programs. First, the faculty commitment to research is coupled with an active intention and practice of including undergraduates in their research. These research opportunities for students greatly enhance the depth of their education and significantly improve their options for graduate school. The second distinguishing characteristic of CS at Westmont comes from the small intimate nature of the program. The faculty enjoy the opportunity and privilege of working one on one with students in course work to ensure that concepts are acquired. Thus, students are not left behind when difficult concepts are introduced as may happen in programs at larger universities. Similarly, our size allows us to support students when they want to combine CS with another major or to create an individual major.

Context: Where We Are
The excellence and rigor with which we pursue the fundamentals and the distinctive characteristics of our program are set against and within a rich multi-faceted context consisting of the liberal arts, Christian faith, social and community life and service,

and simply a fantastic physical surrounding.

CS and the Liberal Arts

Studying CS at a liberal arts institution such as Westmont is particularly enriching because of the strong influences from the complete range of disciplines. A computer scientist's ability to solve problems is substantially enhanced by exposure and training in analytical techniques practiced in history or literary criticism. Our understanding of diverse computer languages is broadened and deepened by exposure to multiple natural languages and the study of linguistics. The creativity necessary to construct complex algorithms that solve difficult problems is in part developed through exposure to the fine arts. More importantly, the ability to communicate with peers, advisors, managers, and customers is critical to a successful career in computer science; the liberal arts emphasis on communication enables our graduates to serve as leaders in a field that has traditionally suffered from low communication skills. In essence, a liberal arts education addresses the development of the whole person and we believe that building a rigorous mastery of computer science only makes sense within such a context.

CS and Christianity

Computer science at Westmont lives and breathes in the context of a Christian faith perspective. What this means for CS is that studies of computation inform our growing faith, and that faith guides our study of computer science. There are a number of ways that this interaction can take shape, but two of the most significant would be in the areas of service and leadership. As computers have become ubiquitous beyond any other technological device, our students have the opportunity to exercise Christian service through their chosen vocations, regardless of specialty. We seek to develop a heart of service in ourselves and our students. Just as importantly, computer scientists have the awesome responsibility of guiding a discipline that holds tremendous promise as well as danger for humanity. Fully embracing our faith, we provide and develop leadership by pursuing scholarship that engages issues that will impact our society now and in the future.

CS and Social Contexts

At Westmont, we have achieved and maintained a social community context that defies the norms and stereotypes of computer science. We recognize that in order to be effective in their future careers – either in graduate school and beyond or in the commercial sector – our students must be effective communicators and problem solvers in group contexts. As a faculty, we have taken this requirement and turned it into significant element of our nature. Most of our courses involve group projects of one kind or another; we actively address interpersonal issues and group dynamics inherent in the processes of software development and problem solving. Beyond the classroom, we foster community strength and interpersonal skills through regular social gatherings both on and off campus. In every situation, we seek to develop an enjoyment of each other as social beings created in God's image.

I.2. Student Learning Outcomes

1. **Core Knowledge.** Know the core ideas and methods in the field of computer science.
2. **Communication.** Be able to communicate ideas in writing or orally, following standard conventions of the discipline.
3. **Creativity.** Be able to independently learn new ideas and techniques and to formulate and solve a novel problem in computer science.
4. **Connections.** Be able to incorporate computer science knowledge and skill into a wider interdisciplinary framework and especially into a personal faith and its accompanying worldview.

These four learning outcomes are unchanged from our previous report.

II. Data and Interpretation

II.1. Assessment of Learning Outcomes

The Learning Outcome Matrix in Table 1 summarizes the current assessment program in computer science. Many of the designations in this matrix are preliminary and will be reviewed and revised as necessary during the Spring of 2010.

The Computer Science Program Roadmap in Figure 1 expands on the information in the matrix, including extracurricular activities and other possible sources of assessment data.

The four subsections (II.1.i–iv) that follow these two graphics detail what has been done over the last academic year for each learning standard.

Learning Outcome Matrix: Major in Computer Science				
Student Learning Outcomes	Core Knowledge	Communication	Creativity	Connections
Meaning	Know the core ideas and methods in the field of computer science.	Be able to communicate ideas in writing or orally, following standard conventions of the discipline.	Be able to independently learn new ideas and techniques and to formulate and solve a novel problem in computer science.	Be able to incorporate computer science knowledge and skill into a wider interdisciplinary framework and especially into a personal faith and its accompanying worldview.
Introduced	CS 5, 10*, 15*	CS 10*, 15*	CS 10*, 15*	CS 15*, 50
Developed	CS 30*, 45	CS 30*	CS 30*	CS 116, 150
Mastered	CS 105, 116, 120*, 125, 130*, 135, 140, 145	CS 120*, 130*, 192*, 195*, 198*	CS 192*, 195*, 198*, MA 180	CS 190SS, CS 195*, Emphasis courses from other depts.
Assessment strategy	Major Field Test in Computer Science	Writing samples scored with rubric	Externally reviewed presentations and papers	Reflective paper scored with rubric
Tentative benchmark	50% above 75th percentile	75% show improvement during term	50% produce some externally reviewed work	TBD
Links to learning standards	Critical-Interdisciplinary Thinking, Active Societal and Intellectual Engagement (Effective Participants)	Written and Oral Communication, Research and Technology	Critical-Interdisciplinary Thinking, Active Societal and Intellectual Engagement (Lifelong Learning, Responsibility)	Christian Orientation, Diversity, Active Societal and Intellectual Engagement (Christian Vocation)

Notes: $*$ = required for major. One of CS 50, PHI 104, PHI 113 is required for the major.

Table 1: Tentative learning outcome matrix.

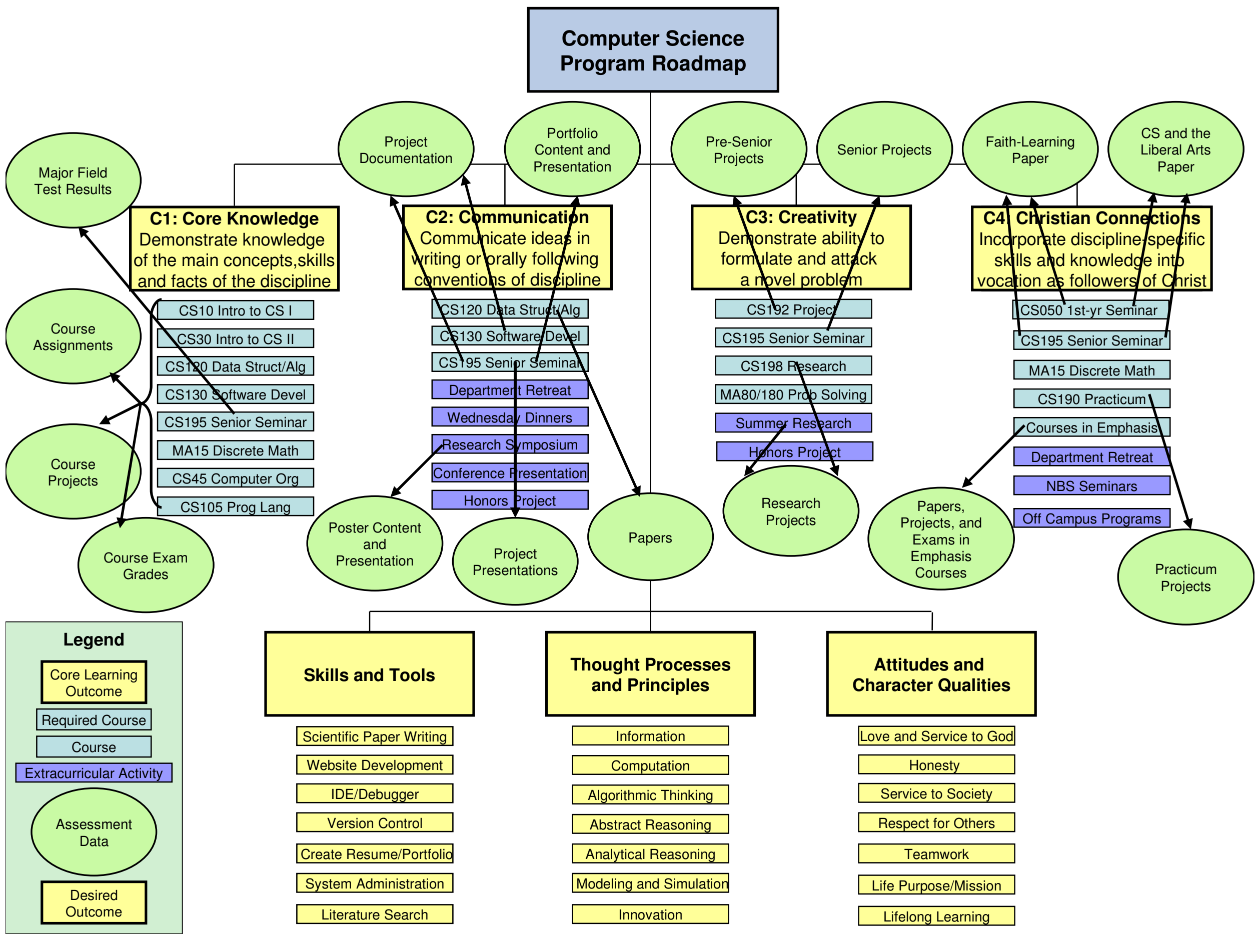

Figure 1: Computer Science Program Curriculum Roadmap.

II.1.i Core Knowledge

Starting with the class of 2008, all graduating seniors in computer science are required to take the ETS's Major Field Test in Computer Science (external link). The results for 2009 graduates are as follows:

Student ID	Date Taken	Score	%ile
X	4/9/2009	160	≥ 70
Y	4/29/2009	154	≥ 60

Table 2: ETS Major Field Test in Computer Science results, 2009.

For this year, these results do not meet our tentative benchmark: 50% of students scored above the 75th percentile of students taking the test nationally. However, cumulative results over the last two years (since we started testing students with the ETS Major Field Test instrument) do satisfy our goal, as two out of four of our students (50%) scored above the 75th percentile. Furthermore, our 2009 student X scored in the 74th percentile by interpolation. However, this tentative benchmark may need to be revised downward. After acquiring additional data for 2010 graduates, we will revisit this issue.

The Educational Testing Service will not release subscore data until at least five people have taken the test. With a current total of four graduating seniors having taken the test, we will have to wait until at least 2010 to get further information on subscores. Subscore data will tell us more than raw score data, because it will indicate areas in which students are doing well and areas which need improvement.

II.1.ii Communication

As recorded in our six-year plan, we intend to focus on the Communication learning outcome during the 2011-2012 academic year.

II.1.iii Creativity

The following students were involved in research during the past year:

Summer 2009: Sarah Coburn (Junior), Robin Elliot (Junior), Kelsey Marshman (Sophmore)
Spring 2009: Ben Fisk (Senior), Sarah Coburn (Junior), Robin Elliot (Junior), Kelsey Marshman (Sophmore), Morgan Vigil (Freshman), Aaron Panchal (Freshman)

Fall 2008: Ben Fisk (Senior)

The following posters and presentations were made (* indicates student author).

Ben Fisk* and Wayne Iba, *Cross Talk: Exploring the Intersection of Computer Science and Philosophy*, poster at Westmont Summer Research Celebration, September 2008.

Aaryn Smith*, Kelsey Marshman*, Robin Elliott* and Kim Kihlstrom, *A system model of intrusion-tolerant systems*, poster at Westmont Summer Research Celebration, September 2008.

Kelsey Marshman*, Robin Elliott*, Aaryn Smith* and Kim Kihlstrom, *StarblabIT: Design and implementation of an intrusion-tolerant communication system*, poster at Westmont Summer Research Celebration, September 2008.

Undergraduate research remains an area of emphasis and strength for the department. Although we have no peer-reviewed publications for the past twelve-month period, our graduates exceeded our benchmark (50% of graduates produce some peer-reviewed work) for the second year in a row. As a junior, one graduate published a peer-reviewed paper and in addition won the best student poster prize at a second conference. Our other graduate participated in and published research in a second major discipline.

II.1.iv Connections

During the past year, the department focussed on our fourth learning standard. We introduced a first-year seminar (CS050) that, together with the senior seminar, serves as one of two bookends for our program. The first-year seminar introduces students to Philosophy with a focus on information and computation as entrees into logic, epistemology, metaphysics and ethics. This course has been approved to satisfy the Philosophical Reflections on Truth and Value component of the General Education's introduction to the Christian liberal arts. As such, we intend for students to grasp the importance of Philosophy, the connections between Philosophy and Computer Science, and the interactions between one's faith commitments and academics.

In addition to other goals, our senior seminar (CS195) is intended to guide students in articulating deeper connections among their advanced computer science coursework, the major as a whole, their individual faith commitments and other academic disciplines. Approximately one-third to one-half of the course will be devoted to the connections learning outcome. Our assessment plan calls for an evaluation of students' ability to articulate connections during the first-year seminar and again during the senior seminar.

We have designed a preliminary rubric for assessing student performance in this area. We want to evaluate students' abilities in two areas. First, we want students to develop the ability to articulate interactions and relationships between their faith and scholarly activities and pursuits. Second, we want students to articulate similar interactions and relationships between computer science and other academic disciplines.

For each of these two qualities, we assess students abilities at three levels: lacking, adequate, or superior. Students lacking these qualities are unable to identify (let alone develop) any interactions or relationships. Students deemed to have an adequate level of ability will perhaps identify, but not develop, an insightful interaction or relationship. Alternatively, some students demonstrating an adequate level may identify and carefully develop superficial relationships. Either of these levels of performance are assessed as adequate. Finally, students may identify and develop *insightful* interactions and relationships and are said to have acquired a superior level with respect to this learning outcome.

We offered our first-year seminar (CS050) for the first time during Fall 2008; this first offering was truncated by the Tea Fire in November of 2008. The senior seminar will not be offered until the Spring of 2011. Because of the fire, students did not write papers on the interaction between faith and academic disciplines. Instead, we assessed their ability to make connections based on an essay question given as part of the final exam (Dec. 2008). The question required students to discuss "the *interactions* among [their] personal philosophical commitments, personal faith, and ... particular behavior regarding [copyright]." In a hint, they were reminded to focus on *interactions* rather than an ethical dilemma. This question addresses only the first part of this learning outcome (connections between faith and scholarly activities); consequently, we applied only the relevant part of the rubric in our assessment.

The computer science faculty gathered during the summer of 2009 to collectively review student responses on this exam question. A sample of 5 out of 15 essays were reviewed by the department. Initial assessment by the course instructor found the responses of 8 students to be lacking, of 4 students to be adequate and of 3 students to be superior. We found that faculty consistently agreed on the performance levels for the sampled student work.

Reflections triggered by this collective assessment concern the rubric and the essay prompt. We discussed the rubric and the prospect of adding a fourth performance level between lacking and adequate. Our consideration was motivated by the bulk of students in the lacking category (80% of this class was either lacking or adequate). However, we decided that we need additional data, we need to more explicitly address connections during the course, and we do not expect most students taking CS050 to acquire a superior ability in this area after only this first course.

Second, we recognized the value of a more regularized writing prompt for essay questions by which we intend to evaluate students' abilities to discuss the types of connections that we desire them to make. Assessment work on this learning standard will be continued during 2009-2010, particulary in the form of standardized prompts or prompt templates that may be customized to fit the needs of particular course contexts.

II.2. Interpretation of Results

The preliminary indications of our assessment work so far continue to show that the program is effectively promoting the outcomes of Core Knowledge and Creativity. The other two outcomes, Communication and Connections, are going to be harder to assess, and work on these outcomes will be a priority for the next few years. Assessment work in the area of Connections this past year provides a rubric for evaluating student work and a baseline of data from a first-year seminar for our future program review activities.

III. Using the Results and Next Steps

The computer science curriculum has undergone continual revision since its reinception in 1999. This revision has been necessitated by the nature of the discipline: on the national level, technology, techniques, and pedagogy have undergone many changes in past years.

While we do not yet have enough results of assessed data to justify changes in the computer science curriculum, the process of crafting learning outcomes and assessment strategies has helped focus the design of our curriculum.

The current 2009–2010 catalog reflects the most recent changes to the computer science major. These changes reflect the addition of a first-year seminar course, CS050, which serves to introduce students to computer science as a liberal art in a Christian tradition. The curriculum roadmap illustrates how our assessment strategy is related to the current major. To ensure inputs and provide assessment data for the Communication, Creativity, and Connections outcomes, all students are required to take a senior seminar, participate in research, produce significant written work in Software Development, and study ethics, preferably from a disciplinary perspective in CS 50.

For the next two academic years, one of the two faculty in computer science will be on sabbatical (Spring and Fall, 2010). Nevertheless, for this coming academic year (2009-2010), we will again focus on the fourth learning outcome: Connections. In addition, we will review our assessment and benchmark for the first outcome: Core Knowledge. In particular, the computer science faculty plan to do the following:

- Decide on a mechanism and prompt for reflective papers in first-year and senior seminars.
- Apply the rubric to student papers written during Fall 2009 and revise as necessary.
- Decide on appropriate benchmarks.
- Review the use of the MFT to assess students' acquisition of core knowledge
- Review tentative benchmark for student performance on the MFT.

In addition, the program plans to continue the assessment activities of the other learning outcomes:

- Administer the MFT, discuss the results, and revisit benchmarks.
- Collect and analyze more writing data and revisit benchmarks.
- Continue to involve students in peer-reviewed research.

Throughout this process, the computer science faculty will consider revisions to several components of this report: the learning outcome matrix, the curriculum roadmap, and the six-year plan.

IV. Data for Program Review

The next several pages contain data that will be helpful when the six-year report is compiled in 2014.

Faculty Information for Wayne Iba, 2008–2009

Date of Hire: 2003

Sex and Ethnicity: Male Caucasian

Rank: Associate Professor

Tenure Status: Tenured (May, 2009)

Teaching Load:

	Classes	# students	# advisees	Other departmental responsibilities	New Preps
Fall 2008			32		1
	CS 10	32			
	CS 50	15			$\surd$
Spring 2009			12		0
	CS 116	8			$\surd$
	CS 125	3			$\surd$
Average load	2	14.5	20		0.5
Mayterm					
Ind. Studies	7				$\surd$
Internships					

Table 3: Teaching load for Wayne Iba, 2008–2009.

Note: Computer Science faculty currently teach 5 courses per year. Wayne Iba received a course release for chairing the Academic Resources Committee.

Faculty Information for Kim Kihlstrom, 2008–2009

Date of Hire: 1999

Sex and Ethnicity: Female Caucasian

Rank: Associate Professor

Tenure Status: Tenured

Teaching Load:

	Classes	# students	# advisees	Other departmental responsibilities	New Preps
Fall 2008	(Europe semester)				
Spring 2009	CS 005 CS 120	28 9	13		0
Average load	18.5	20			0
Mayterm					
Ind. Studies	2				
Internships					

Table 4: Teaching load for Kim Kihlstrom, 2008–2009.

Note: Computer Science faculty currently teach 5 courses per year. Kim Kihlstrom had a grant pay for a course release this year.

Computer Science Alumni Survey

LAST	FIRST	MIDDLE	Deg.	YEAR	Current Ocupation (title, company, etc.)
Eastvold	Benjamin	Seth	BS	2001	
Chambers	Luke	Wilson	BA	2002	
Te Velde	Michael	Henry	BA	2002	
Conant	Tyler	John	BS	2002	
Andrews	Christopher	Richard	BA	2003	
Hanson	James	Daniel	BS	2003	
Lassonde	Nicholas	Adam	BS	2003	Startup company (Vesora?)
Gibbs	Anna	Katheryn	BS	2004	
Labarbera	Benjamin	Carl	BS	2004	
Carroll	Dustin		BS	2004	Grad student finishing Masters at MBARI
Hanson	James	Rodney	BS	2004	
Thurman	Jesse	Lee	BS	2004	
Sullivan	Jonathan	Robert	BS	2004	System admin consultancy
Cox	Joseph	Walter	BS	2004	Cytrix
Kishiyama	Kevin	Takeo	BS	2004	Software developer
Cook	Patti	Lee	BS	2004	
Broadus	Robert	Lee	BS	2004	IT
Roby	Seth	A.	BS	2004	
Jensen	Brian	Alan	BS	2005	Opera singer
Ritchey	Christopher	Charles	BS	2005	
Phillips	Christopher	Dale	BS	2005	Grad student finishing Masters at UCSB
Johnson	Kerby	Obadiah	BS	2005	Finished Masters at UCSB and working Genentec
Yankoski	Michael	George	BS	2005	
McElfresh	Rebecca	Joy	BS	2005	
Newell	Ryan	M	BS	2005	
Cantrell	Thomas	Bruce	BS	2005	Software developer at Green Hills Software (SB)
Jensen	Bradley	Alan	BS	2006	
Shank	Daniel	Philip	BS	2006	Software developer/tester at Appfolio (SB)
Hilp	John	Tilford	BS	2006	
Kaddatz	Matthew	Martin	BS	2006	
Burwell	Nicholas	James	BS	2006	Software developer at Callwave
Watters	Kyle	Padia	BS	2006	PhD grad student in Physics at Stanford
Evans	Anne	Iten	BS	2007	High School computer science teacher, CO
Cannon	Cuyler	Elisha	BS	2007	
Holm	Joshua	Thor	BS	2007	Software developer at Callwave
Magnuson	Michael	Carl	BS	2007	
Raub	Stephen	Benjamin	BS	2007	Software developer at Green Hills Software (SB)
Willson	Julia	Kathleen	BS	2007	
Barquer	Kristin	Noel	BS	2007	Grad student in Kinesiology (Univ Iowa?)
Stewart	Joel		BS	2008	
Rufener	Daniel		BS	2008	
Gardner	Michael		BS	2009	PhD program in Physics at Univ. Calif Davis
Fisk	Benjamin		BA	2009	Local support services contractor

Work with other departments and offices:

The computer science faculty have worked closely with the chair of the GE committee and other departments teaching courses analogous to CS050. In addition to assessments in CS050 for our department's Connection outcome, this coordination is leading toward assessments of the GE outcomes.

Throughout the Spring and Summer of 2009, the computer science faculty has been meeting with an external consultant. These meetings have sharpened the department's focus, clarified our mission, and reprioritized many of our tasks and activities.

V. Time-line for Completion of the Six-year Report

After discussions two years ago with Assessment Coordinator Marianne Robins, the department agreed to separate the program review schedules for mathematics and computer science. The Computer Science program will submit the Six-Year report in 2014. Table 5 gives the current year-by-year plan for assessment and program review in computer science. This plan will be reviewed and revised during the 2009-2010 academic year.

Year	Program review overall	Details for assessment work
2009–10	Actively pursue the creation of a third faculty line in computer science, using program review data.	Ongoing annual tasks. Continue progress on the Connection learning standard (#4). Review Core Knowledge learning standard (#1).
2010–11	Discuss the implications of a third faculty line for curriculum and program review. Discuss the transition to a separate computer science department, once a third faculty member is hired.	Ongoing annual tasks. Review Creativity learning standard (#3).
2011–12	Review contributions to GE.	Ongoing annual tasks. Review Communication learning standard (#2).
2012–13	Discuss quality of preparation for graduate school.	Ongoing annual tasks. Discuss/Revise learning standards.
2013–14	Prepare for six-year program review report, due 9/15/2014.	Ongoing annual tasks. Summarize assessment work from past six years.

Table 5: Tentative six-year plan for assessment and program review in computer science. This plan will be revisited during the 2009–2010 academic year.