

# COMMISSION FOR HIGHER EDUCATION

Friday, September 14, 2012

## DECISION ITEM A-1:

### Associate of Science in Computer Science To Be Offered by Ivy Tech Community College at Valparaiso, South Bend, Fort Wayne, Lafayette, Terre Haute, Columbus, Evansville, Bloomington, and Statewide via Distance Education Technology

#### Staff Recommendation

That the Commission for Higher Education approve the Associate of Science (A.S.) in Computer Science To Be Offered by Ivy Tech Community College at Valparaiso, South Bend, Fort Wayne, Lafayette, Terre Haute, Columbus, Evansville, Bloomington, and Statewide via Distance Education Technology, in accordance with the background discussion in this agenda item and the *Program Description*; and

#### Background

Ivy Tech Community College currently offers associate degrees in Computer Information Systems and Computer Information Technology in all 14 of its regions. In FY2011, these programs enrolled a total of 6,293 headcount or 3,516 FTE students statewide. In that same year, these programs graduated a total of 457 students. Vincennes University also offers several associate degrees in this field at its Vincennes and Jasper campuses, which together enrolled 293 headcount or 265 FTE students in FY2011 and produced 28 graduates. Associate degrees in Information Technology are common at comprehensive community colleges nationwide.

Most of the coursework required for the A.S. in Computer Science already exists, although five new three-hour courses, as well as a one-hour capstone course, will need to be developed. As is the case with new programs developed by the College, a program chair will need to be designated at each campus, but in many instances the positions will be filled by existing faculty.

The College seeks authorization for this degree to provide students with more options in the Computer Science area, including transfer opportunities. An articulation agreement with IUPUI has been developed, and the College is working on developing agreements with other public campuses. It is the Commission's understanding that additional articulation agreements will be in place by the end of the academic year.

The staff further understands that the College is working with one or more regional campuses to complete an articulation agreement. With respect to agreements with regional campuses, the staff would emphasize the desirability to single articulation pathways, whereby Ivy Tech students could complete the same curriculum,

which would articulate with baccalaureate programs at the regional campuses in exactly the same way, thereby eliminating the need for community college students to tailor their program to meet differing curricular requirements among the regional campuses. This approach, of course, would call for greater collaboration and coordination among the regional campuses than has taken place previously.

Consistent with the way Ivy Tech approaches distance education offerings, the eight campuses will collaborate in delivering this program online.

### **Supporting Documents**

*Program Description* - A.S. in Computer Science To Be Offered by Ivy Tech Community College at Valparaiso, South Bend, Fort Wayne, Lafayette, Terre Haute, Columbus, Evansville, Bloomington, and Statewide via Distance Education Technology

## Program Description

### A.S. in Computer Science

To be offered by

**Ivy Tech Community College at Eight Campuses and  
Statewide via Distance Education Technology**

#### 1. Characteristics of the Program

##### a. **Campus(es) Offering Program**

New program to Ivy Tech Community College

##### b. **Scope of Delivery (Specific Sites or Statewide)**

Statewide Distance Education (All Regions – All Campuses)

Region 1 – Northwest (Valparaiso campus)

Region 2 – North Central (South Bend campus)

Region 3 – Northeast (Fort Wayne campus)

Region 4 – Lafayette (Lafayette campus)

Region 7 – Wabash Valley (Terre Haute campus)

Region 10 – Columbus (Columbus campus)

Region 12 – Southwest (Evansville campus)

Region 14 – Bloomington (Bloomington campus)

##### c. **Mode of Delivery (Classroom, Blended, or Online)** – all three modes will be utilized

##### d. **Other Delivery Aspects (Co-ops, Internships, Clinicals, Practical, etc.)**

##### e. **Academic Unit Offering Program:** School of Applied Science and Engineering Technology

The suggested CIP Code for the new program is 11.0701, defined as follows:

A general program that focuses on computers, computing problems and solutions, and the design of computer systems and user interfaces from a scientific perspective. The program includes instruction in the principles of computational science, and computing theory; computer hardware design; computer development and programming; and applications to a variety of end-use situations (NCES, *Classification of Instructional Programs*. 2000 edition).

#### 2. Rationale for Program

##### a. **Institutional Rationale (e.g. Alignment with Institutional Mission and Strengths)**

The implementation of this program further strengthens the college's science, technology, engineering, and mathematics (STEM) curricula. The Computer Science Associate Degree program will prepare students to work in fields that span computational theory through cutting-edge development of computing solutions. Computer Science provides a foundation that permits its graduates to adapt new technologies through three principal categories that include (a) designing and building software; (b) developing effective ways to solve unique problems in the computer sciences; and (c) devising new and better ways of using computers to address real-world challenges confronting our citizens. Graduates of the program will gain a foundation and proficiency on processes that handle and manipulate large amounts of information that have applications in business, education, game theory, modeling, health, information security, life sciences, manufacturing, and other related careers. Guided by the premise that technology is a business enabler, planning for our future information systems and related curricula is strongly aligned with the mission of the college:

*Ivy Tech Community College prepares Indiana residents to learn, live, and work in a diverse and globally competitive environment by delivering professional, technical, transfer, and lifelong education. Through its affordable, open-access education and training programs,*

*the College enhances the development of Indiana's citizens and communities and strengthens its economy.*

This program clearly fits into the college's current strategic plan, *Accelerating Greatness*, under Strategy 2: Ensure that Indiana citizens, workforce, and businesses are globally competitive

- Objective 2.1 Become a recognized leader in providing fundamental, applied, and technical knowledge and skills in programs that support Indiana's citizens and its economy
- Objective 2.2 Increase Ivy Tech's relevance and value to Indiana's employer community

The college works with employers to determine what skills they need from their employees while also providing training that meets a variety of needs – including associate degrees that result in jobs in high demand fields and that transfer to four-year colleges and universities.

The Computer Science program is expected to have an impact on future program developments. The increased capacity brought through this program – enhanced equipment, laboratory facilities and expanded coursework- will be building blocks for other future degree programs in related engineering and life sciences fields of study.

The college has a long history of providing related information technology education. The Computer Information Systems is one the oldest and largest programs in the college. The curriculum was based on the concept that for many years entry into this profession started with application programming. With the introduction of miniaturization and the distribution of personal computing both in organizations and to individuals in the broader population, other careers such as computing repair and networking became more popular. However, the business model for information systems continues to evolve and the power of technology continues to change the profession for those individuals pursuing a career in this area. For example, combinations of outsourcing and high order development tools have greatly reduced the number of traditional application programmers. Organizations large and small have shifted from in-house development of applications to purchased software.

In partial response to the technological evolution our faculty in 2005 and 2006 modified the curriculum and split courses into two groups – Computer Information Systems, and Computer Information Technology. While Computer Information Systems curriculum provides students with knowledge about programming languages, operating systems, database management systems, and web design, Computer Information Technology emphasizes network management and security, computer hardware and support and operating systems administration. The Computer Science curriculum completes the educational continuum of this discipline at the college.

#### **b. State Rationale**

Alignment with *Reaching Higher, Achieving More*

- Completion – creating clear, efficient pathways for on-time college completion  
Students who are balancing work and family responsibilities will benefit from the online course offerings to stay on track to on-time graduation in this program that requires 60 credit hours and is aligned to four-year curriculum for those who wish to complete a baccalaureate degree.
- Productivity – prioritizing resources to high-demand academic programs & reducing duplication of academic programs and services  
This is a new program for the college that complements existing information technology curriculum, and is expected to generate more enrollment in the college's higher level math and science courses.

**c. Evidence of Labor Market Need**

- i. National, State, or Regional Need**
- ii. Preparation for Graduate Programs or Other Benefits – n/a**
- iii. Summary of Indiana DWD and/or U.S. Department of Labor Data**
- iv. National, State, or Regional Studies**

The Computer Science program can serve any geographic area with a concentration of employers in the information systems industry. With the concept of distributed computing that is now found in many areas of the state, large and smaller cities with the capability of supporting information technology will employ graduates from this program.

The academic areas of computer information systems and computer information technology are already large programs for the college. With the advent of an expanding advanced manufacturing and life science sectors throughout the state, computer science will become more integral to support not only the information technology sector but these other sectors, as well. The computer science sector can be described as a discipline that involves the understanding and design of computers and computational processes. The discipline spans the range from theory through programming to the cutting-edge development of computer solutions.

The computer science program would position our students to take several career paths. Besides transferring to a senior institution to complete their bachelor's degree, computer science majors may assist in the designing and implementation of new software. This discipline is also creative in such a way that graduates may also help devise new ways to use computers by innovatively applying computer technology to solve unique business issues. In addition computer science graduates can be involved in the planning managing of an organization's technological infrastructure.

Information technology is big business, and Indiana like many other states is increasingly seeking to attract this sector as a way to promote economic development. Information as noted earlier is integral to the growth of advanced manufacturing and the life sciences sectors given their dependence on the accurate processing of data that results in the creation of business information.

Communities are looking to attract information technology and their related sectors to their areas. Ivy Tech is being responsive to provide marketable and transferable education in computer science, to fill existing information technology jobs, and to work with communities as a catalyst for attracting high skill, high wage jobs to the marketplace. Further, the College is committed to encourage graduates to pursue further education in the field both at the undergraduate and graduate level.

Moreover, the state is just beginning to tap the power of technology. The digital age has vastly expanded individual access to all sorts of information and resources which include education materials. Simultaneously, the Internet has fostered a culture of sharing as there exists currently an exchange of content. New technologies such as Web 2.0 has blurred lines between content producers and consumers while creating a paradigm shift from a focus on the access of information to the access to other people. Why may this be important?

Computers certainly have evolved over the past forty years from the centralized, large mainframe operations largely kept from the public eye to the distributed network processing that have become integral to the business and individual work life found today. Computing of yesteryear supported scientific inquiry and large business enterprises. The computing of today especially with current networking technologies and cost reductions provide information to of individuals and small enterprises that was unknown in prior decades. For example, the miniaturization and power of network computing today allows for the use of sophisticated modeling techniques and gaming theory to advance societal, business, governmental, and individual goals.

The information industry is moving to blend the divide between providers and consumers of information in such a way that whole new industries are forming under the umbrella of new media. New media is a term meant to blend digital and computerization in a networked environment. This presents significant implications for training and education, entertainment, both mathematic and digital modeling, as well as a host of other industries. At its core foundation, all of this requires computer education to support the pieces and parts that include programming, networking, and management of large caches of information.

Indiana has both large and small companies engaged in various aspects of information technology including computer software engineers, applications, computer systems analysts, network systems and data communications, systems software, computer administrators, systems managers, and database administrators. The computer science program will align itself with economic development efforts initiated for Indiana not only in the information sector but also to support advanced manufacturing and the life sciences. While there are many employers capable of hiring our graduates, the state appears to be experiencing growth in the information sector. Recently, the Bloomington Economic Development Corporate completed a Request for Information from a major employer that could attract 1,300 new information jobs to Bloomington specifically and the state in general. Should this employer relocate to the area, the undisclosed company would invest approximately \$100 million in investment and training. The job opportunities for this and other employers in the state include server management, systems operations, database management, storage management, as well as project management.

The Indiana Department of Workforce Development identified in its *Hoosier Hot 50 Jobs Data* computer science, computer software, engineering and applications among its top jobs for the state. With the increasing state interest in both the life sciences and advanced manufacturing, Ivy Tech recognizes that information technology is a sector of high interest currently in the state and certainly represents significant potential employment area for our citizens.

The Computer Science program is designed for graduates to transfer to senior institutions for baccalaureate opportunities. According to the most recent U.S. Bureau of Labor Statistics survey, employment of computer scientists is expected to grow by 24 percent from 2008 to 2018. Similarly, the Department of Workforce Development's *Hoosier Hot 50 Jobs Data* project increases in computer science employment from between 2004 and 2014 from 3,920 to 5,670 or a 44% increase. Likewise, the state is expected to increase its database administration employment 37% from 1,600 to 2,200 individuals in the same time period. This degree program will position our students to be educated in complex information systems problem solving, as well as position our students for transfer to senior institutions. The need for computer engineers to design storage and information sharing systems, facilitate human-machine interaction, and develop complex algorithmic solutions will be a major factor in the rising demand for computer scientists.

The Indiana Economic Growth Regions (EGRs) in which these degrees will be offered rank computer software engineer, computer systems analysts, and computer/mathematics occupations as key occupational opportunities. According to the Indiana Department of Workforce Development website *Hoosiers by the Numbers*, EGR 1, EGR 7, EGR 10 and EGR 12 have the large projections of employment within computer software engineering in the state with between 26.4% and 32.4%, while EGR 2 and EGR 14 are 52.8% and 57.8%, respectively. Likewise, EGR 3 and EGR 4 show increase in employment projections within the computer systems analyst field with percentages of 17.6 and 26.8, respectively. These EGRs around the state have demonstrated an increase in companies inquiring about these related computer science fields.

The literature further notes that the Information Technology Associate of America reported in their Workforce 2003 report that the information systems industry essentially bottom out in 2002, and the number of jobs in this area began to regain their footing to the extent that The Bureau of Labor Statistics predicts additional increases in the number of jobs through the year 2014 (between 5 and 36 percent depending on job category). Similarly, computer science provides critical support for our STEM (science, technology, engineering and mathematics) fields, which are the necessary pillars for our state and country’s infrastructure for our continued survival in the global marketplace. The National Academies of Science, Engineering and Medicine in their 2007 study of “Rising Above the Gathering Storm,” as well as other authors suggest that our advantages in the marketplace of science and technology have begun to erode, which suggests that planning our future educational for computer education is important.

While the current economic conditions experienced in 2008 may contribute to a less than otherwise desired growth in jobs in information systems and other career fields, there are myths that must be countered as the college moves forward in this arena. Among the myths in this field include the notion that there are no jobs; that information system jobs are moving off-shore; and that information systems degrees are worthless. The information systems literature suggest otherwise. Jobs are being created in information systems as noted earlier in the bureau statistics, and career fields are developing in collateral fields because of the explosive growth in digital communications and related fields. While it is also true that jobs have been sent overseas to lower-cost areas of production, it remains true that highly skilled jobs related to a company’s core competency in information systems or their core business processes have remained in the United States. Finally, it should be noted that graduates with technical skills are needed; however, those students leaving education institutions with solid knowledge of business fundamentals, communications abilities both verbal and written, and those with abilities to analyze and propose solutions to business problems are and will continue to be valued above all.

**v. Surveys of Employers or Students and Analyses of Job Postings**

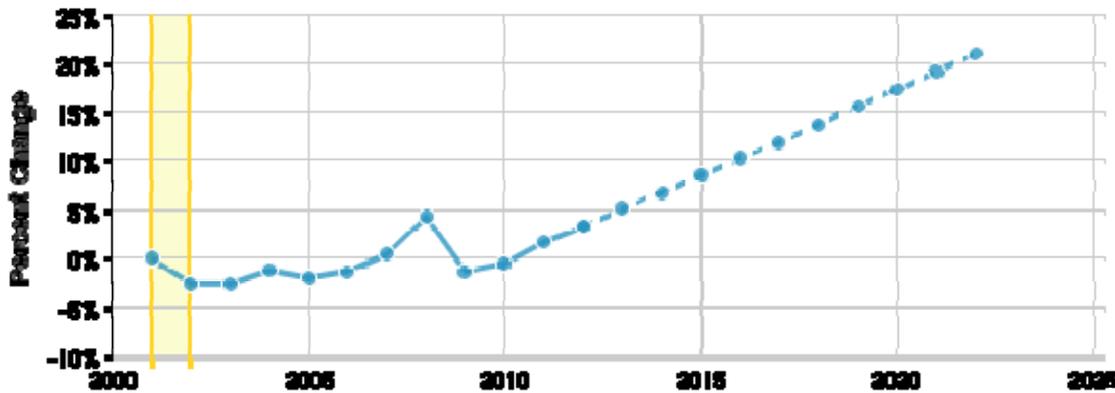
Sample of Recent Job Postings in Indiana  
 Computer Software Engineers, Applications

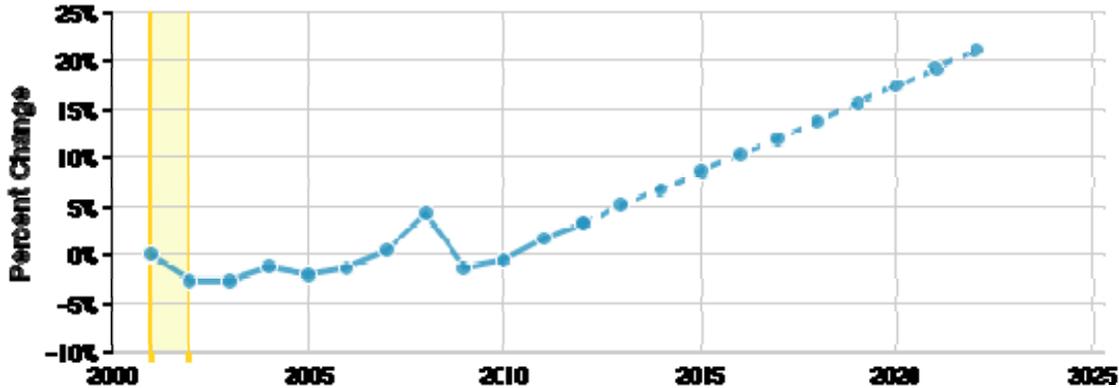
Annual Openings Estimate (2012) - 315

315

Current Job Postings

356





vi. Letters of Support

3. Cost of and Support for the Program

a. Costs

i. Faculty and Staff

Approximately 75% of the required coursework in the program are general education classes that are currently on the college inventory and support other programs of study. No new faculty and staff are required for these classes, although as enrollments build over the years, additional faculty will be added to meet the demand.

The following new programmatic coursework will be introduced to support the program:

**PROGRAM SPECIFIC CORE - 16 CREDITS**

CSCI	101	Computer Science I	3
CSCI	102	Computer Science II	3
CSCI	105	Discrete Logic for Computers	3
CSCI	202	Computer Science III	3
CSCI	210	Database Systems	3

**INSTITUTIONAL REQUIREMENT**

CSCI	279	Capstone Course	1
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The first year of implementation will require eight program chair faculty to be hired. Some of these positions will be new to the college and others will be filled by transferring faculty from existing program. Faculty employed in this position will have a minimum of a master’s degree in Computer Science or related field. Because the labs will be shared with other related programs, the college does not anticipate additional lab tech support as the program is launched.

**ii. Facilities**

The Computer Science Program on-site delivery will require a laboratory class room with additional computer hardware and software to support student learning along with audiovisual equipment and multimedia equipment for instruction. All campuses currently have adequate laboratory spaces to meet these needs.

**iii. Other Capital Costs (e.g. Equipment)**

The program will require additional software to support course competencies, and some will need to upgrade existing equipment. The average estimate per campus to initiate the program is \$10,000.

**b. Support**

**iv. Nature of Support (New, Existing, or Reallocated)**

Required faculty will be funded from a combination of funding from reallocated positions and grant funding, which is anticipated to be replaced by enrollment growth once the funding ceases.

**v. Special Fees above Baseline Tuition**

There are no additional program assessments planned for Computer Science majors. It is expected that some of the programmatic classes will include an additional course fee, estimated at \$15-\$30 and consistent with fees applied to other computer technology courses in the college inventory. Standard in-state and out-of-state tuition and fees for Ivy Tech students will apply to this program. The 2012-13 in-state tuition is \$111.15/credit hour. The fee for all Ivy Tech on-line courses, currently set at \$20/student, applies to classes taken via distance education methodology.

**4. Similar and Related Programs**

**a. List of Programs and Degrees Conferred**

**i. Similar Programs at Other Institutions**

A baccalaureate degree in Computer Science is offered at all major Indiana universities and at several of the regional campuses such as Purdue University Calumet and Indiana University Southeast. Several of the private colleges and universities, such as DePauw and Rose-Hulman Institute of Technology, also offer this major.

**ii. Related Programs at the Proposing Institution**

- Computer Information Systems – Associate of Applied Science and Technical Certificate
- Computer Information Technology – Associate of Applied Science and Technical Certificate

Computer science graduates advance the field of information technology (IT) through research and innovation. They are different from the bulk of IT professionals in that they focus on developing new technology rather than using or repairing existing technology, which is the primary focus of Ivy Tech's existing degrees.

**b. List of Similar Programs Outside Indiana**

Nationwide, computer science and/or computer programming and engineering are commonly found at major community college such as Valencia in Florida and Sinclair as well as the on-line for profit institutions (University of Phoenix, Baker, Kaplan, etc.).

**c. Articulation of Associate/Baccalaureate Programs**

Ivy Tech's Computer Science program is aligned with the Association for Computing Machinery (ACM) curricular recommendations, and thus contains content that would align itself with the senior institutions following the ACM standards.

The Associate of Science in Computer Science is designed for articulation into a Bachelor of Science in Computer Science or Applied Computer Science – a program that is either stand-alone curriculum or combined with mathematical sciences at many of the senior institutions throughout the state. The program has a signed articulation with the new "Applied Computer Science" degree from Indiana University – Purdue University – Indianapolis (Please see Appendix for articulation details). Other 4 year institutions have shown interest in articulating such as Indiana State University, an Indiana University Regional campus and several private institutions. The general education portion of the associate's degree will transfer following the new general education transfer core, and the professional courses align with coursework at the four-year institutions.

**d. Collaboration with Similar or Related Programs on Other Campuses**

Ivy Tech campuses offering the program on-campus will collaborate to develop the statewide curriculum.

**5. Quality and Other Aspects of the Program**

**a. Credit Hours Required/Time To Completion – 60 credit hours**

Full time college-ready students are able to complete the program in a two year period

**b. Exceeding the Standard Expectation of Credit Hours – n/a**

**c. Program Competencies or Learning Outcomes**

**Computer Science  
Program Objectives**

- Demonstrate problem-solving strategies including the role, implementation strategies, and properties of algorithms.
- Manipulate and configure fundamental programming constructs: syntax and semantics, data types, numeric operations, control structures, functions, methods and parameter passing.
- Demonstrate understanding of object-oriented concepts of computer programming: classes, objects, inheritance, exception handling, GUI, and event-driven programming.
- Demonstrate an understanding of virtual machines, interpreters, and compilers in their use with programming languages.
- Discuss machine level representation of data including numeric representation and number bases and representation of character data.
- Understand and employ various search and sort algorithms.
- Demonstrate an understanding of database systems and database query languages, entity relationship modeling, and normalization
- Employ functions, relations, sets, digital logic, propositional logic, Boolean algebra, descriptive statistics, and elementary number theory.
- Exhibit an understanding of the importance of data backup, recovery and security
- Discuss the social context of computing: history and evolution of ideas and machines, social impact of the computer, professionalism, and code of ethics.
- Continue their education at a senior institution.

**d. Assessment**

Evaluation of the program will be done according to program review protocols currently in place at Ivy Tech Community College. These include enrollment trends, faculty trends, student performance, student retention, achievement of technical and general education outcomes, job placement, graduate follow-up surveys, and on-going evaluation by the program advisory committee.

- a. The student learning outcomes will be assessed and measured at the end of the student's program through a project based portfolio to be completed in the capstone course. The comprehensive project will be a complete computer program with source code, documentation, test data and results, and any additional materials that apply. A rubric will be designed by the faculty for this purpose.
- b. The overall performance of the program will be measured through the use of a standardized rubric scoring system. The students will be rated on the individual elements of the program using current "best practices" of the computer programming community.
- c. The main goal of an associate degree program is to produce graduates that transfer to baccalaureate programs to earn bachelor degrees in the corresponding field. The assessment will be used to measure how successful students of the program are in earning their baccalaureate degree.

d. The results of the assessment will be analyzed and compared to the goals and objectives of the program. These comparisons will be used to strengthen and revise areas of the individual courses to better meet the overall goals of the program.

**e. Licensure and Certification**

Currently there is no licensure or certifications incorporated in the Computer Science program. The Associate of Science in Computer Science is designed for articulation into a Bachelor of Science in Computer Science or Applied Computer Science.

**f. Placement of Graduates**

Computer science is a field that offers many career options to graduates across almost all economic sectors. An associate degree program in computer science could prepare students for careers various related positions, such as:

- Computer programmers
- Computer support specialists
- Systems analysts

Although some employers prefer that a computer technician or programmer has a bachelor's degree, employees may be hired with an associate's degree and some experience. Employers often provide additional on-the-job training.

Interested individuals may also choose to pursue a bachelor's degree in computer science and become computer software engineers, advanced computer programmers or systems managers or administrators. Additional certifications may improve employment and career advancement opportunities.

**g. Accreditation**

Currently, the Computer Science program has not selected a program specific accreditation body to establish accreditation. There are accrediting bodies for computer science such as the ACM, and their requirements were considered extensively in the development of this curriculum. Accreditation through the appropriate body will be sought upon successful implementation of the Computer Science program and in consultation with the primary transfer partners.

**6. Projected Headcount and FTE Enrollment and Degrees Conferred**

**Degree Conferred - Associate of Science in Computer Science**

**Enrollment projections noted in Appendix**

**NEW ACADEMIC DEGREE PROGRAM PROPOSAL SUMMARY**

June, 2012

Institution/Location: Ivy Tech Community College at Eight Campuses and Statewide via Distance Education Technology  
 Program: A.S. in Computer Science

	Year 1 FY2012	Year 2 FY2013	Year 3 FY2014	Year 4 FY2015	Year 5 FY2016
<b>Enrollment Projections (Headcount)</b>					
Full-Time	34	54	66	69	72
Part-Time	42	67	81	85	89
<b>Total</b>	<b>76</b>	<b>121</b>	<b>147</b>	<b>154</b>	<b>161</b>
<b>Enrollment Projections (FTE)</b>					
Full-Time	34	54	66	69	72
Part-Time	20	32	38	40	42
<b>Total</b>	<b>54</b>	<b>86</b>	<b>104</b>	<b>109</b>	<b>114</b>
<b>Degree Completions Projection</b>	<b>0</b>	<b>0</b>	<b>13</b>	<b>14</b>	<b>26</b>
CHE Code: 12-17					
Campus Code: 10040, 8423, 9926, 10039, 8547, 10038, 9925, 35213					
County: Porter, St. Joseph, Allen, Tippecanoe, Vigo, Bartholomew, Vanderburgh, Monroe					
Degree Level: Associate					
CIP Code: Federal - 110701; State - 110701					