

COMPUTER SCIENCE
UNDERGRADUATE HANDBOOK

FOR THE COMPUTER SCIENCE MAJOR IN THE
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
COLLEGE OF ENGINEERING

AT THE
PENNSYLVANIA STATE UNIVERSITY

Effective Summer, 2009

Department of Computer Science and Engineering:
342G Information Sciences and Technology Building
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(Some) University Park Offices and Phone Numbers

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Dean's Office, 101 Hammond Building	865-7537
Associate Dean of Undergraduate Studies, 101 Hammond Building	863-3750
International Engineering Programs, 205 Hammond Building	863-1032
Office of Student Services, 208 Hammond Building	863-1033
Engineering Advising Center, 208 Hammond Building	863-1033
Assistant Dean for Student Services, 208G Hammond Building	865-7539
Minority Engineering Program, 208 Hammond Building	865-7138
Women in Engineering Program, 208 Hammond Building	863-1080
Cooperative Education Program, 205 Hammond Building	863-1032
Center for Adult Learner Services (Outreach), 128 Outreach Building	863-3887
Career Services, 101 MBNA Career Services Center	865-2377
Information Technology Services (ITS) Help Desk, 215 Computer Building	863-2494
Counseling and Psychological Services (CAPS), 501 Student Health Center	863-0395
Disability Services, 116 Boucke Building	863-1807
Penn State World Campus (correspondence courses), 128 Outreach Bldg.	865-5403
Division of Undergraduate Studies (DUS), 118 (lobby) Grange	865-7576
University Learning Resource Center, 220 Boucke Building	865-1841
Office of Student Aid (financial), 314 Shields Building	865-6301
Residence Life, 135 Boucke Building	863-1710
Undergraduate Admissions (for transferring credits), 201 Shields Bldg.	865-5471
Schreyer Honors College, 10 Schreyer Honors College (Atherton Hall)	863-2635
Veterans Programs, 325 Boucke Building	863-0465
General Information, HUB Desk, First Floor Lobby	865-2000

Sources of Information

This *Handbook* provides program information specifically for the undergraduate Computer Science major. It should be used as a supplement to the *College of Engineering Undergraduate Programs Guide* that you received as a freshman. The information in this *Handbook* pertains to students who entered or will be entering the major in Summer 2009, Fall 2009, or Spring 2010 (2009 Program year). Students entering the major in an earlier year should refer to the appropriate earlier version of the *Handbook*. Students in pre-major (ENGR) status may use this *Handbook* as a reference for scheduling; however, your official degree requirements will be established when you enter the major. For information about the Computer Science degree, refer to the *Computer Science Undergraduate Handbook*. All of these documents are available in the department office, 342G Information Sciences and Technology Building. (If you are at a campus other than University Park, you should contact the College of Engineering representative at your location).

Although this *Handbook* lists all requirements for the Computer Science major, only those specific to Computer Science are described in detail. Other requirements are discussed only briefly with references to more comprehensive supporting documents. Hard copies of these documents can be obtained from a Dean's office or local bookstore. Many are available on-line through the World Wide Web. A list of useful web resources is provided below. For easy reference, resource names are printed in bold throughout the *Handbook*.

- [**Semester Course Schedules**](#)
- [**DUS Advising Resource**](#)
- [**Department of Computer Science & Engineering**](#)
- [**Penn State University**](#)
- [**Engineering Advising Center**](#)
- [**Bulletin of Baccalaureate Degree Programs**](#)
- [**University Faculty Senate Policies for Students**](#)
- [**Student Guide to General University Policies and Rules**](#)
- [**Registrar's Schedule of Courses**](#)
- [**General Education & Cultural Diversity in the Curriculum**](#)
- [**eLion**](#)

For additional information, you can contact the [**Engineering Advising Center**](#) (208 Hammond, 863-1033), the Assistant Dean for Student Services (208G Hammond, 865-7539), or the [**Department of Computer Science and Engineering**](#) (342G Information Sciences and Technology Building, 865-9505). The structure in the Department of Computer Science and Engineering includes a Director of Academic Affairs and an Undergraduate Secretary, both of whom can provide information and guidance during your academic career.

The Computer Science Major

The Department of Computer Science and Engineering was created in 1993 with the merger of the Computer Engineering Program and the Computer Science Department. The department offers B.S. degrees in both Computer Science (CMPSC) and Computer Engineering (CMPEN) through the College of Engineering.

The Computer Science undergraduate major at Penn State has two phases. The first phase introduces the concepts of modern computer science, including structured programming languages and efficient, productive programming. The second phase examines data structures, programming languages, and computer systems in detail. Course work involves writing computer applications and polishing programming skills.

The baccalaureate program in Computer Science provides a fundamental education to prepare students for positions in industry, government, education, or commerce, or to pursue graduate study. The Computer Science curriculum is organized with two goals in mind. First, upon graduation a student must be prepared to meet immediate demands in solving computational problems. Second, a student must have sufficient understanding of basic principles and concepts in computer science to avoid technological obsolescence in the rapidly changing information technology environment.

This program is intended to produce computer science professionals and not merely technicians with some training in computer programming. Success requires a strong aptitude in mathematics. Because of the close relationship to computer science, simultaneous degrees and dual majors in Computer Engineering and Computer Science are not permitted.

Advising and Procedures for Major

If you are a first- or second-year student at University Park who is intending to major in Computer Science, you will see an adviser at the [Engineering Advising Center](#) (EAC), 208 Hammond Building, 863-1033. This office is open Monday through Friday, 8:00 a.m. to 5:00 p.m. (Walk-in advising is available but appointments are encouraged).

If you are a junior or senior who has been admitted into the Computer Science major or a University Scholar, you will be assigned a faculty adviser in the Computer Science and Engineering Department. If you do not know your assigned adviser's name or office address, ask in the department office in 342G Information Sciences and Technology Building. This information is also available from [eLion](#).

Required courses for the Computer Science major and a suggested schedule are given on the following pages. Information about all majors at Penn State are listed in the [Bulletin of Baccalaureate Degree Programs](#). The *Bulletin* is updated yearly and should be used along with this Handbook. Exceptions to the *Bulletin* are noted here.

The final responsibility for selecting courses and meeting degree requirements is yours. The role of your adviser is to suggest, recommend, and remind you of the requirements of the major and rules of the University. (Two helpful references for University procedures on-line are: [University Faculty Senate Policies for Students](#) and the [Student Guide to General University Policies and Rules](#). When meeting with your adviser, always take a copy of your recent audits, grade reports, transcript, your present schedule, and your plan for at least the next semester's courses.

Because computer science is such a rapidly changing field, adjustments in course content and/or course offerings should be expected. It will be to your advantage to keep abreast of new course offerings, current course enhancements, and allowable course substitutions through regular contact with an adviser and the department office.

Entrance to the Major - To qualify for the Computer Science major:

- (1) You must complete MATH 140, MATH 141, PHYS 211, and CMPSC 122 with a grade of C or better in each by the end of the spring semester of your sophomore year. **Note that, unlike other engineering majors, Computer Science requires CMPSC 122, not CHEM 110, for determining entrance to the major.**
- (2) You must be enrolled in the College of Engineering (ENGR major) or DUS (declared as heading toward engineering major).
- (3) You should complete at least two full semesters of coursework appropriate to the major. You should be taking CMPSC 311 and CMPEN 271 during your second year in order to make normal progress. Be sure you're accumulating credits at a minimum rate of 30 credits per calendar year. Be aware that a deferred grade or withdrawal should be discussed with an adviser so that your schedule is not judged "inappropriate."
- (4) Early in the spring semester of your sophomore year, you must complete a Sophomore Application to Major form and submit it by the published deadline. (See *College of Engineering Undergraduate Programs Guide* for more details).

In summary, during your first two years, you must complete CMPS 122, MATH 140, MATH 141, and PHYS 211 with a grade of C or better in each. You must declare your intended major as CMPS, schedule your courses wisely, and maintain a high grade point average.

Change of Major – If you discover an interest in other areas of study or you are not admitted into Computer Science, you should explore other possible majors and alternatives at the [Engineering Advising Center](#) or at any [DUS Advising Resource](#).

Concurrent Major – Concurrent majors will not be allowed in Computer Science and Computer Engineering.

Registration – Each semester, you register for classes by planning what you need to take (referring to this *Handbook* and the *College of Engineering Undergraduate Programs Guide*), by checking with your adviser, and then by following the instructions in the *Schedule of Courses* that is published each semester. (You can also find out what courses are still open, what courses have had sections added, etc., on-line at the [Registrar's Schedule of Courses](#) website).

Re-ordering your course schedule will not necessarily delay graduation. The key to completing 126 credits over 4 years is to average approximately 16 credits per semester. Though many students do maintain this pace, it is not unusual for students to take lighter loads some semesters and to delay graduation. Needed credits are often taken during the summer (not necessarily at University Park) or by independent learning. Some students will elect to attend for a 9th semester. Some electives are not offered every semester, so please be careful in your scheduling. This is especially true for co-op students.

Schedule Changes -- Schedule adjustments (course adds/drops) may be made online using [elion](#) during the first 10 calendar days of each semester. Detailed instructions, costs, and deadlines are provided in the *Schedule of Courses*. After this time, you may still adjust your schedule, but any change is considered a late add or a late drop and requires an adviser's signature. *You have a limit of 16 late-drop credits, so consultation with your adviser is important.* (REMEMBER: A student who has not yet been admitted to the major should seek advice at the [Engineering Advising Center](#); a student who has been admitted should see the assigned faculty adviser in Computer Science and Engineering).

General Education – All students at the University are required to complete 46 credits of General Education. A General Education course can be identified by its course suffix. You will partially meet these requirements by taking specific courses required for the Computer Science major, and by following the general guidelines below.

General Education consists of the following categories:

- first year seminar - at least 1 credit - courses with the designation PSU will fulfill this requirement, as will courses with the suffix FYS
- writing/speaking - 9 credits - course suffix of GWS
- quantification - 6 credits - suffix of GQ
- health and physical activity - 3 credits - suffix GHS
- natural sciences - 9 credits - suffix GN
- arts - 6 credits - suffix GA
- humanities - 6 credits - suffix GH
- social and behavioral sciences - 6 credits - suffix GS

College of Engineering students will follow the University's General Education guidelines; refer to the College of Engineering *Undergraduate Programs Guide* and to the University's **Baccalaureate Degree Programs Bulletin** for a complete list of available courses.

Check with your adviser if you would prefer to develop a sequence of 9 credits in arts, humanities, or social and behavioral sciences by substituting 3 credits from one of the other 2 areas. Please note: students may take a level III language course and use it as one of the AHS courses, but it cannot be the only course in an area; thus, it can only be the second or third course of the 9-6-[not the 3] sequence in any of the AHS areas. Petitions to use the 9-6-3-sequence option for meeting AHS requirements will be approved as long as the above requirements are met.

Writing Requirement – All Penn State students have a Writing Across the Curriculum graduation requirement. You must complete at least 3 credits of writing-intensive courses selected from "W" courses offered within the major or college of enrollment. Courses in the Computer Science major that fulfill this requirement are CMPSC 483W (Software Design Methods) and CMPSC 431W (Introduction to Database Management Systems).

Diversity Requirement – Beginning summer 2005, the [Intercultural and International Competence \(GI\) requirement](#) has been replaced by a requirement in United States Cultures (US) and International Cultures (IL). Courses approved to fulfill this requirement will be designated as US, IL, or both US and IL. The [degree audit](#) will monitor the completion of the requirement for each student based on his/her program year.

Students admitted to baccalaureate degree status after spring 2005 must complete 3 credits in US and 3 credits in IL. If a student takes a 3-credit course that is both US and IL, to complete the requirement, he/she must take another 3-credit course that is US, IL, or both US and IL. Education abroad courses and other credit-bearing experiences such as internships that meet this requirement will be designated as US, IL, or both US and IL.

A good reference, updated yearly, is the small blue booklet [General Education and Cultural Diversity in the Curriculum](#). Education Abroad is another option for fulfilling the diversity requirement.

Sixth Semester Audit – During your sixth semester, the Department will send you a copy of your transcript or a computer audit and a requirement checklist for the major. A copy of the checklist appears on the last page of this *Handbook*. You must fill out the requirement checklist and return it so that your progress can be checked and any problems resolved before graduation. **If you have questions on your audit, it is your responsibility to talk to your adviser and/or to the undergraduate secretary (in 342H Information Sciences and Technology Building).**

Graduation Requirements – To graduate from the University, every student must:

- (1) Complete the course requirements for his or her major;
- (2) Earn at least a 2.0 cumulative grade-point average for all courses taken at the University; and
- (3) Earn at least a C in each of these courses: CMPSC 121, CMPSC 122, CMPSC 221, CMPSC 360, CMPEN 271, CMPSC 311, CMPEN 331, CMPSC 473, CMPSC 461, CMPSC 465, MATH 140, MATH 141, PHYS 211.

Credit Acquisition – In addition to taking courses at any Penn State campus, you can earn credit through Independent Learning (correspondence) or by transferring credits from another school. Before taking a course at another university, check with the Admissions office and your adviser to be sure the course will transfer usefully.

Cooperative Education Program – The cooperative education program provides work experience by alternating periods of academic study and full-time employment in industry or government. The program typically starts at the beginning of the junior year and consists of three rotations, providing a cumulative work experience of one year.

If you have interest in the co-op program, you should obtain advising no later than your fourth semester from the designated co-op adviser, who will help you plan work and study schedules. You may earn up to 6 credits toward graduation in the Department List requirements.

If you prefer less of a time commitment, you can pursue one or more summer internships. You earn 1 credit per internship (maximum of 2 credits total) toward graduation in the Department List requirements.

If you are not a formal co-op or internship student, you may still take related summer jobs; however, you may not claim credits for jobs you arrange outside of the formal programs.

Honors Program – Students in the Schreyer Honors College (Atherton Hall, 863-2635) have the option of pursuing an honors degree in Computer Science by participating in the Computer Science Honors Program. See an honors adviser if you are interested in finding out more about this program. (The department office, 342G Information Sciences and Technology Building, can identify the honors advisers for you).

Minors – A minor is a specialization of at least 18 credits that supplements a major. Some courses may concurrently meet the requirements of our major. Popular minors for students in our department include:

- 1) Engineering Leadership Development
- 2) Engineering Entrepreneurship
- 3) Mathematics
- 4) Business/Liberal Arts

Other Issues – For additional information on minors, withdrawal, leaves of absence, concurrent majors, change of major, satisfactory/unsatisfactory credits, and other academic issues, refer to [University Faculty Senate Policies for Students](#). For information on campus and community resources (parking, libraries, museums, etc.; referrals for returning adult students, minority students, veterans, women), refer to *Easy Access*, available during orientation and published by Student Life.

Any exceptions made in the degree requirements must be approved and documented, usually using a college petition form. Inquiries about exceptions and general degree requirements should be taken to the Computer Science and Engineering Department Office (342G Information Sciences and Technology Building), to your adviser, or to the [Engineering Advising Center](#). (Note that such petitions will NOT be accepted during the semester that you plan to graduate).

Academic Integrity – Recognizing not only the value of integrity in the academic environment, but also its value for the practicing computer scientist and for society at large, we in the Department urge you to act as a responsible professional while you are a student. Academic integrity is defined as follows in Faculty Senate rule 49-20:

"Academic integrity is the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students."

It is commonly accepted that people learn better if they can interact, discuss, and assist each other in solving problems and understanding concepts. Yet persons submitting identical homework papers overstep the bounds of beneficial interaction. You are encouraged to discuss homework assignments. You may discuss what you are supposed to do, the general algorithm and data structures that might be used. The furthest that cooperation is allowed is to assist another student in debugging their code. Do not, for any reason, show another student sections of your code or write sections of code for another student. Any collaboration that exceeds these guidelines will be considered cheating. Clearly, professionals share ideas but they should not use another's work without clear acknowledgement of who did the work. Academic dishonesty in any form is not condoned or tolerated.

Computer Science Topics -- Students achieve breadth in computer science through a series of required courses. Background in software related areas is gained through CMPSC 121, CMPSC 122, CMPSC 221, CMPSC 311, CMPSC 465, CMPSC 461, and CMPSC 473. Background in theory is gained through CMPSC 360, CMPSC 465, and CMPSC 464. Background in hardware areas is gained through CMPEN 271, and CMPEN 331. Though taken infrequently by Computer Science majors, the course CMPEN 472 examines hardware and software aspects of microcomputer systems.

Specialization is obtained by the students' selection of technical electives. Students must select 12 credits of technical electives (6 credits from CMPSC 471, CMPSC 450, CMPSC 458, CMPSC 442, CMPSC 451, CMPSC 455, CMPSC 456, CMPSC 466, CMPSC 467, CMPSC 468, CMPEN 362, CMPEN 454, and EE 456, select 3 credits from any 400-level CMPSC/CMPEN course, and select 3 credits from CMPSC 483W or CMPSC 431W).

Issues related to the integration of hardware and software, and hardware-software tradeoffs are discussed in the required courses CMPSC 311, CMPEN 331, and CMPSC 473, as well as some elective courses such as CMPEN 472 and CMPEN 473.

Students receive an appropriate introduction to various specialized mathematics topics in a sequence of required courses that include: CMPSC 360, STAT 318, STAT 319, and MATH 220. A variety of methods for modeling computer processes and systems are introduced in the required courses CMPSC 465, CMPEN 331, and CMPSC 473.

Students can learn to use a number of computer-aided design tools through certain laboratory courses and in regular lecture courses. These include a digital schematic capture and simulation tool in CMPEN 271; a hardware design language and a microprocessor emulation system in CMPEN 473; a hardware description language similar in CMPEN 431; logic design CAD tools in CMPEN 471; VLSI CAD tools in CMPEN 411; and computer vision software tools in CMPEN/EE 454.

All students learn at least three programming languages, JAVA, C, and C++. Assembly language is studied in CMPEN 331 and CMPEN 472. In CMPSC 461, students are exposed to various language features associated with any programming language. Students make extensive use of both Microsoft and UNIX operating systems.

Program Requirement Summary Chart – On the next pages, you will find a semester-by-semester chart of what courses to take with notes describing any choices to be made or restrictions to be followed. Please realize that although all the courses listed are required for the degree, they need not be taken during the semesters shown in the charts. You should be sure to check course prerequisites before you deviate from the suggested schedule. **Care should be exercised to be sure core courses are taken in the proper sequence and in a time frame allowing you to meet entrance to major requirements.** A total of 126 credits are required for graduation.

Suggested Schedule of Courses by Semester

SEMESTER 1

16 credits

MATH 140 or 140E GQ (Calculus I)*	4
CMPSC 121 GQ (Intermediate Programming)*	3
ENGL 15 or 30 GWS (Rhetoric & Comp.)	3
GA, GH, or GS course	3
GA, GH, or GS course	3

SEMESTER 2

15 credits

MATH 141 or 141E GQ (Calculus II)*	4
PHYS 211 (Mechanics)*	4
CMPSC 122 (Intermediate Programming)*	3
GA, GH, or GS course	3
First Year Seminar ^{xi}	1

SEMESTER 3

16 credits

CMPSC 221 (OOP with Web Applications)*	3
MATH 230 (Calculus III)	4
MATH 220 (Matrices)	2
PHYS 212 (Electricity & Magnetism)	4
CAS 100 A/B (Effective Speech)	3

SEMESTER 4

14-15 credits

CMPEN 271 (Intro to Digital Systems)*	3
Natural Science (GN) ^{vi}	2-3
GA, GH, or GS course	3
ENGL 202C GWS (Technical Writing)	3
CMPSC 311 (Systems Programming)*	3

SEMESTER 5

16 credits

CMPEN 331 (Comp. Organization & Design)*	3
CMPSC 360 (Discrete Math for CMPSC)*	3
GA, GH, or GS course	3
STAT 318 (Elementary Probability)	3
Foreign Language (level 002 proficiency) ^{ix}	4

SEMESTER 6

15 credits

CMPSC 465 (Data Structures & Algorithms)*	3
CMPSC 473 (Operating Systems)*	3
STAT 319 (Applied Statistics in Science)	3
CMPSC Computer Science Elective ⁱⁱ	3
GA, GH, or GS course	3

SEMESTER 7

17.5 credits

CMPSC 483W or CMPSC 431W	3
CMPSC 464 (Intro. to the Theory of Comput.)	3
Department List (General Elective) ^x	4
Department List (General Elective) ^x	3
Supporting Course ^{viii}	3
Health & Physical Activity (GHA) ^y	1.5

SEMESTER 8

16.5 credits

CMPSC 461 (Programming Lang. Concepts)*	3
Department List (General Elective) ^x	3
Supporting Course ^{viii}	3
CMPSC Computer Science Elective ⁱⁱ	3
CMPSC/CMPEN 400-level ^{**}	3
Health & Physical Activity (GHA) ^y	1.5

Subscripts in Roman numerals refer to the Graduation Requirements Notes on the following pages.

* A grade of C or better in these courses is required for graduation; (MATH 140, MATH 141, PHYS 211, and CMPSC 122 require a C or better for entrance to the major). If a course requires a "C" or better and the course is a prerequisite for another course, a "C" is required to meet the prerequisite.

** Select 3 credits from any 400-level CMPSC/CMPEN course. No CMPSC 494H or CMPSC 496 may be substituted.

GRADUATION REQUIREMENTS NOTES

Many of the courses below have prerequisites; some prerequisites are shown in parentheses; others are given in the Bulletin.

I. Computer Science and Engineering (33 credits):

- CMPSC 121 GQ (3) – Introduction to Programming Techniques
(prerequisite: 2 entrance units in MATH)
- CMPSC 122 (3) – Intermediate Programming
(prerequisite: CMPSC 121)
- CMPSC 221 (3) – Object Oriented Programming with Web-Based Applications
(prerequisite: CMPSC 122)
- CMPSC 360 (3) – Discrete Mathematics for Computer Science
(Concurrent: CMPSC 122)
- CMPEN 271 (3) – Introduction to Digital Systems
(Concurrent: PHYS 212)
- CMPSC 311 (3) – Systems Programming
(prerequisite: CMPSC 221)
- CMPEN 331 (3) – Computer Organization and Design
(prerequisite: CMPEN 271; CMPSC 121 or CMPSC 201)
- *CMPSC 473 (3) – Operating Systems
(prerequisite: CMPSC 311; CMPEN 331)
- *CMPSC 461 (3) – Programming Language Concepts
(prerequisite: CMPSC 221; CMPSC 360)
- *CMPSC 464 (3) – Introduction to the Theory of Computation
(prerequisite: CMPSC 465)
- *CMPSC 465 (3) – Data Structures and Algorithms
(prerequisite: CMPSC 360 or MATH 311W)

*Neither transfer credits nor study abroad credits may substitute.

II. Computer Science Electives (12 credits):

One course must be selected from CMPSC 483W or CMPSC 431W to satisfy the writing intensive requirement. **Some courses are NOT offered every semester or even every year.**

Select 3 credits from any 400-level CMPSC or CMPEN course.

Select 6 credits from:

- CMPSC 471 (3) – Introduction to Compiler Construction
(prerequisite: CMPSC 461)
- CMPSC 450 (3) – Concurrent Scientific Programming
(prerequisite: CMPSC 121, CMPSC 201 or CMPSC 202; MATH 220; MATH 230 or MATH 231)
- CMPSC 458 (3) – Fundamentals of Computer Graphics
(prerequisite: CMPSC 311; MATH 220; MATH 230 or MATH 231)
- CMPSC 442 (3) – Artificial Intelligence
(prerequisite: CMPSC 122 or equivalent. Concurrent: CMPSC 465)
- CMPSC 451 (3) – Numerical Computations
(prerequisite: 3 credits of programming; MATH 230 or MATH 231)
- CMPSC 455 (3) – Introduction to Numerical Analysis I
(prerequisite: MATH 220; MATH 230 or MATH 231; and 3 credits of programming)
- CMPSC 456 (3) – Introduction to Numerical Analysis II
(prerequisite: CMPSC 455)
- CMPSC 466 (3) – Combinatorics and Graph Theory
(prerequisite: CMPSC 465)
- CMPSC 467 (3) – Factorization and Primality Testing
(prerequisite: CMPSC 360 or MATH 311W)
- CMPSC 468 (3) – Theory of Automata, Languages, and Computability
(prerequisite: CMPSC 122; MATH 315, MATH 311W or CMPSC 360)

- COMPEN 362 (3) – Communication Networks
(prerequisite: COMPEN 271; Concurrent: STAT 301 or STAT 318 or STAT 401 or STAT 414 or STAT 418)
- COMPEN 454 (3) – Fundamentals of Computer Vision
(prerequisite: MATH 230 or MATH 231; CMPSC 121 or CMPSC 201)
- EE 456 (3) – Introduction to Neural Networks
(prerequisite: CMPSC 201 or CMPSC 202; MATH 220)

Select 3 credits from:

- COMPSC 483W (3) – Software Design Methods
(prerequisite: COMPSC 221; COMPSC 465; ENGL 202C)
- OR
- COMPSC 431W (3) – Database Management Systems
(prerequisite: COMPSC 221; ENGL 202C)

**A student may take only one course for credit from COMPSC (MATH) 451 and 455.*

If you are considering graduate school, be sure to talk to your adviser about the best additional courses for you to schedule.

III. Communications (9 credits):

- ENGL 15 GWS (3) – Rhetoric and Composition
(ENGL 30 GWS may be substituted)
- ENGL 202C GWS (3) – Technical Writing
- CAS 100 A/B (3) – Effective Speech

IV. Quantification and Statistics (20 credits):

Mathematics (14 credits):

- MATH 140 GQ (4) – Calculus with Analytic Geometry I
- MATH 141 GQ (4) – Calculus with Analytic Geometry II
- MATH 220 GQ (2) – Matrices
- MATH 230 (4) – Calculus and Vector Analysis
combination of MATH 231 (2) and MATH 232 (2) may be substituted

Probability and Statistics (6 credits):

- Either STAT (MATH) 318 and 319
or STAT (MATH) 414 and 415
or MATH 444/445
(STAT/MATH 418 may substitute for 318 or 414)

V. Health Sciences and Physical Education (3 credits):

The Health Science/Physical Activity (ESACT) requirement can be met by taking one 3-credit course

VI. Natural Sciences (10-11 credits):

Physics (8 credits):

- PHYS 211* GN (4) – General Physics (mechanics)
- PHYS 212* GN (4) – General Physics (electricity, magnetism)
(*Preferred sequence is PHYS 211 and 212, but may not be available at all campuses).

Additional natural science (2-3 credits):

Select 2 credits from PHYS 213 GN(2), 214 GN(2), or 3 credits from any GN except as excluded below.

These GN courses are NOT acceptable:

- ASTRO 1, 10, 11, 120, 140; all BI SC courses; All below CHEM 110;
PHYS 250, 251, all below PHYS 211, GEOSC 20

To receive *General Education* credits, you must take these combinations:

BIOL 11 and 12
CHEM 110 (or 106) and 111
CHEM 112 and 113
MICRB 106 and 107

VII. Arts, Humanities, Social and Behavioral Sciences, Diversity (18 credits):

Six credits are required in each of the 3 categories: Arts (A), Humanities (H), and Social and Behavioral Sciences (S), as listed under the University's General Education Guidelines [see the University's [Baccalaureate Degree Programs Bulletin](#)]. See page 5 [this handbook], **General education**, for an explanation of the 9-6-3 sequence as it pertains to AHS courses. You may use your Arts, Humanities, or Social or Behavioral Sciences sciences selections to fulfill the University's Diversity requirement (see page 6 [this handbook], **Diversity requirement***). A work chart follows.

Arts

Humanities

Social Sci.

Diversity Focused Course

*For diversity-focused courses, see [General Education and Cultural Diversity in the Curriculum](#) on-line and the *Semester Course Schedules*.

VIII. Supporting courses (6 credits):

Guidelines: Choose six credits of 400-level non-CMPSC/CMPEN courses, having a common theme, that support a career in computer science. Acceptable alternatives include 6 credits in mathematics (MATH) and/or statistics (STAT); 6 credits in information sciences (IST), or 6 credits in engineering leadership/entrepreneurship (ENGR, excluding coop credits). Any deviation from these alternatives requires a petition. Because a petition could be denied, you should seek approval before scheduling the course. Note that you may need to take more than two courses to satisfy the 6-credit requirement.

Examples of courses that would be acceptable include:

- Any courses with the prefix MATH, STAT, IST, EDSGN, or ENGR. These are currently the types of courses most commonly used to fulfill the Supporting Courses requirement and are included explicitly to reduce the number of petitions.
- Technical courses at the 400-level (not CMPSC/CMPEN); e.g., chemistry, physics, biology, engineering (because they provide additional technical depth or breath).
- Courses that relate to business or management; e.g., finance, accounting, marketing, economics (because most CMPSC majors must work in a business environment).
- Courses in linguistics (because the study of language relates to programming languages)
- Psychology, if the courses relate to cognition, perception, learning, memory, vision (because they relate to AI), but not say development through adulthood, abnormal psychology, social psychology, religious approaches to psychology.
- Philosophy, if the courses relate to ethics, logic, science, language, or similar topics.
- Foreign language courses that relate to communication in the language (because of its vale in a global work environment).

Examples of courses that fail to meet the spirit of the new requirement include:

- Crime, Law, and Justice (their one course on computer security is remedial for CMPSC majors).
- History, Sociology, English, Education, Communication, Instructional Systems, Military
- Art, even though it might be loosely related to computer graphics, or web development.
- Music, unless both courses deal with electronic music.
- MATH (STAT) 414, 415, 418, MATH 444, 445 (these courses can only be applied to the statistic's requirement in Section IV).
- MATH (CMPSC) 451, 455, 456, 467 (cross-listed with CMPSC).
- MATH 470, 471, 493 (designed for education majors).

IX. Foreign language proficiency (4 credits)

CMPSC majors are required to demonstrate proficiency equivalent to two semesters of a single foreign language. Since Penn State now requires the equivalent of one semester of a foreign language for admission, most students can meet the CMPSC foreign language requirement in one of the following ways:

- Complete the 4th or higher year of a single foreign language in high school (provide the Department with a copy of your high school transcripts). You must still make up the four credits, however. In effect, four credits are added to your Department List requirement.
- Complete the 2nd (or higher) semester of one foreign language; e.g. SPAN 2.
- Complete two semesters (8 credits) of a NEW foreign language (other than the one you took in high school). Four of these credits can be applied to Department List electives.

If you were admitted to Penn State with a foreign language deficiency, you must complete two semesters (8 credits) of a single foreign language; however, only 4 of those credits can be applied to your degree requirements.

X. Department List (General Elective) Guidelines (10-14 credits)

Choose enough credits to bring the total number of credits up to at least 126. If your Diversity course was not an Arts, Humanities, or Social and Behavioral Sciences course, it may be counted in this list. These are sometimes called approved free electives or general electives, but the following restrictions apply:

- no courses not satisfying minimum requirements for baccalaureate degree program (see course descriptions in *University Bulletin*)
- no courses described as intended for non-science or non-technical majors in course descriptions in *University Bulletin* (**You may take non-technical courses**, but look at the *Bulletin* to be sure the description doesn't say "for non-science majors only").
- no courses similar or remedial to a required course or course already taken (when in doubt, check with your advisor before scheduling the course). For example, you may not include 2 credits of MATH 140A or 2 credits of CHEM 106.
- not ENGL 4, 5, or any other remedial English
- none of the following:
 - Astronomy (ASTRO) 1, 10, 11, 120, 140
 - Biological Science (BI SC) 1, 2, 3, 4
 - Chemistry (CHEM) 1, 3, 108, 101
 - Computer Science (CMPSC) 100, 203
 - Earth and Mineral Sciences (EM SC) 150
 - English as a Second Language (ESL) 004

English as a Second Language (ESL) 004
Language and Literacy Education (LL ED) 5, 10
Mathematics (MATH) 200, MATH below 140
Philosophy (PHIL) 12
Physical Science (PH SC) 7
Physics (PHYS) 250, 251, PHYS below 211
Science, Technology, and Society (S T S) 150
Speech Communication (CAS) 126, 283
Statistics (STAT or MATH) below 318, 401
STAT (MATH) 318, STAT (MATH) 319, STAT (MATH) 414, STAT (MATH) 415, STAT (MATH)
418, MATH 444, 445

- no more than 6 credits of ROTC
- no more than 6 credits of music performance courses
- no more than 3 additional credits of physical education
- no more than 6 credits of Cooperative Education
- no more than 2 credits of Engineering Internship
- no more than 3 credits of CHEM 106
- **IST courses are accepted with the following exception:**
IST 210 – (if the student has completed CMPSC 431W)
IST 220 – (if the student has completed CMPEN 362)

XI. First Year Seminar (1 credit):

Small interactive classes that allow first-year students to meet faculty and alumni, explore different majors and career opportunities, or focus on hands-on projects and skill development.

**Changes in Course Abbreviations
Effective Spring 2008**

New Course	Old Course	Official Course Title
CMPEN 271	CSE 271	INTRODUCTION TO DIGITAL SYSTEMS
CMPEN 275	CSE 275	DIGITAL DESIGN LABORATORY
CMPEN 331	CSE 331	COMPUTER ORGANIZATION AND DESIGN
CMPEN 362	CSE 458	COMMUNICATION NETWORKS
CMPEN 411	CSE 477	VLSI DIGITAL CIRCUITS
CMPEN 416	CSE 447	DIGITAL INTEGRATED CIRCUITS
CMPEN 417	CSE 478	DIGITAL DESIGN USING FIELD PROGRAMMABLE DEVICES
CMPEN 428W	CSE 430W	COMPUTER ENGINEERING PROJECT DESIGN
CMPEN 431	CSE 431	INTRODUCTION TO COMPUTER ARCHITECTURE
CMPEN 454	CSE 486	FUNDAMENTALS OF COMPUTER VISION
CMPEN 455	CSE 485	DIGITAL IMAGE PROCESSING
CMPEN 471	CSE 471	LOGICAL DESIGN OF DIGITAL SYSTEMS
CMPEN 472	CSE 472	MICROPROCESSORS AND EMBEDDED SYSTEMS
CMPEN 473	CSE 473	MICROCOMPUTER LABORATORY
CMPEN 482W	CSE 430W	COMPUTER ENGINEERING PROJECT DESIGN
CMPS 97	CSE 97	SPECIAL TOPICS
CMPS 101	CMPS 101	INTRODUCTION TO C++ PROGRAMMING
CMPS 102	CMPS 101B	INTRODUCTION TO VB PROGRAMMING
CMPS 109	CMPS 140	INTRODUCTION TO DATA PROCESSING WITH COBOL
CMPS 121	CSE 121	INTRODUCTION TO PROGRAMMING TECHNIQUES
CMPS 122	CSE 122	INTERMEDIATE PROGRAMMING
CMPS 200	CMPS 201A	PROGRAMMING FOR ENGINEERS WITH MATLAB
CMPS 201	CMPS 201C	PROGRAMMING FOR ENGINEERS WITH C++
CMPS 202	CMPS 201F	PROGRAMMING FOR ENGINEERS WITH FORTRAN
CMPS 203	CMPS 203	INTRODUCTION TO SPREADSHEETS AND DATABASES
CMPS 221	CSE 221	OBJECT ORIENTED PROGRAMMING WITH WEB-BASED APPLICATIONS
CMPS 295	CSE 295	INTERNSHIP
CMPS 296	CSE 296	INDEPENDENT STUDIES
CMPS 297	CSE 297	SPECIAL TOPICS
CMPS 311	CSE 311	INTRODUCTION TO SYSTEMS PROGRAMMING
CMPS 360	CSE 260	DISCRETE MATHEMATICS FOR COMPUTER SCIENCE
CMPS 431W	CSE 441W	DATABASE MANAGEMENT SYSTEMS
CMPS 442	CSE 481	ARTIFICIAL INTELLIGENCE
CMPS 443	CSE 443	INTRODUCTION TO COMPUTER SECURITY
CMPS 450	CSE 457	CONCURRENT SCIENTIFIC COMPUTING
CMPS 451	CSE 451	NUMERICAL COMPUTATIONS
CMPS 455	CSE 455	INTRODUCTION TO NUMERICAL ANALYSIS I
CMPS 456	CSE 456	INTRODUCTION TO NUMERICAL ANALYSIS II
CMPS 458	CSE 418	FUNDAMENTALS OF COMPUTER GRAPHICS
CMPS 461	CSE 428	PROGRAMMING LANGUAGE CONCEPTS
CMPS 465	CSE 465	DATA STRUCTURES AND ALGORITHMS
CMPS 466	CSE 460	COMBINATORICS AND GRAPH THEORY
CMPS 467	CSE 467	FACTORIZATION AND PRIMALITY TESTING
CMPS 468	CSE 468	THEORY OF AUTOMATA, LANGUAGES, AND COMPUTABILITY
CMPS 471	CSE 421	INTRODUCTION TO COMPILER CONSTRUCTION
CMPS 473	CSE 411	OPERATING SYSTEMS DESIGN & CONSTRUCTION
CMPS 483W	CSE 420W	SOFTWARE DESIGN METHODS
CMPS 494H	CSE 494H	SENIOR HONORS THESIS
CMPS 496	CSE 496	INDEPENDENT STUDIES
CMPS 497	CSE 497	SPECIAL TOPICS
CMPS 498	CSE 498	SPECIAL TOPICS

Graduation Requirements Checklist for B.S. Degree in Computer Science

format is COURSE (grade,credits,semester): e.g., CMPSC 121 (A,3,FA10)

Computer Science and Engineering:

CMPSC 121GQ (,3,) , CMPSC 122 (,3,) , CMPSC 360 (,3,) _____ (33)
 CMPSC 221 (,3,) , CMPSC 311 (,3,) _____
 CMPEN 271 (,3,) , CMPEN 331 (,3,) , CMPSC 464 (,3,) ,
 CMPSC 465 (,3,) , CMPSC 461 (,3,) , CMPSC 473 (,3,)

Computer Science Electives:

CMPSC/CMPEN/EE _____ (,3,) _____ (9)
 CMPSC/CMPEN/EE _____ (,3,) _____
 CMPSC/CMPEN/EE _____ (,3,) _____

Writing Intensive Course:

CMPSC _____ (,3,) _____ (3)

Communications:

ENGL 15 GWS (,3,) , ENGL 202C GWS (,3,) , _____ (9)
 CAS 100 GWS (,3,) _____

Quantification, Statistics:

MATH 140 GQ (,4,) , MATH 141 GQ (,4,) , MATH 230 (,4,) _____ (20)
 MATH 220 GQ (,2,) , STAT 318 (,3,) , STAT 319 (,3,) _____

Health Sciences and Physical Activities:

_____ (, ,) _____ (, ,) _____ (3)
 _____ (, ,) _____

Physics and Natural Sciences:

PHYS 211 GN (,4,) , PHYS 212 GN (,4,) _____ (10-11)
 additional natural science _____ (, ,) _____

Arts, Humanities, Social & Behavioral Sciences, Diversity (indicate GA, GH, GS, & DF):

_____ (, ,) _____ (, ,) _____ (18)
 _____ (, ,) _____ (, ,) _____
 _____ (, ,) _____ (, ,) _____

Supporting Courses, Approved by Adviser:

_____ (, ,) _____ (, ,) _____ (6)

Foreign Language Proficiency:

_____ (, ,) _____ (, ,) _____ (4-8)

Selections from Department List (General Electives):

_____ (, ,) _____ (, ,) _____ (10-14)
 _____ (, ,) _____ (, ,) _____
 _____ (, ,) _____ (, ,) _____

First Year Seminar:

_____ (, ,) _____ (, ,) _____ (1)

TOTAL CREDITS _____ (126+)

_____ (student name) is planning to graduate at the end of _____ Semester, 20____. This is to confirm approval of the supporting courses listed above:

Academic Adviser's Signature _____