



**UNIVERSITY OF THE GAMBIA
DEPARTMENT OF SCIENCE AND TECHNOLOGY
SEPTEMBER 2006**

FULL DESCRIPTION OF COMPUTER SCIENCE (CPS) MAJOR AND MINOR

I. Motivation of the Computer Science (CPS) Major and Minor

There is a significant, undisputed need in The Gambia for teachers and skilled workers who possess a strong background in both Computer Science theory and practical applications. To help fill this urgent need, in the 2006-2007 school year The University of The Gambia (UTG) has begun offering a Bachelor's in Science (BSc) with a major or minor in Computer Science (CPS).

The UTG CPS major and minor programs aim to give students an international-quality Bachelor's-level theoretical understanding of the field of Computer Science with a strong emphasis on the practical applications encountered in today's business of Information Communication Technology. The core of the Computer Science curriculum aims to provide a broad overview of computer science theory, programming, and computing architectures, with an offering of electives allowing the students deeper study in a variety of current, relevant topics in the field of Computer Science.

II. Computer Science Major Requirements

Students wishing to graduate from the University of The Gambia with a major in Computer Science must complete a minimum of 120 credit hours total including:

1. All general education requirements of the University of The Gambia,
2. All departmental requirements of the Department of Science and Technology including introductions to Calculus (MTH101), Physics (PHY101), and Chemistry (CHM101),
3. All 40 credit hours of the twelve (12) Computer Science CORE courses as defined below,
4. At least 15 credit hours in Computer Science ELECTIVE courses as defined below, with at least two courses at the 400 level, and
5. CPS 401, a five (5) credit hour year-long senior research and development project.

Computer Science CORE Courses

| Credit Hours | Course Name and Number | Description |
|---|-------------------------------|--|
| 3 | CPS 111 | Introduction to Information Communication Technology (ICT) |
| 3 | CPS 122 | Introduction to Computer Science |
| 4 | CPS 101 | Computer Programming I |
| 4 | CPS 102 | Computer Programming II |
| 3 | CPS 201 | Computer Logic and Discrete Structures |
| 4 | CPS 212 | Data Structures and Functional Programming |
| 3 | CPS 235 | Computer Architecture |
| 3 | CPS 321 | Theory of Computing I |
| 3 | CPS 422 | Theory of Computing II |
| 3 | CPS 341 | Operating Systems I & Systems Programming |
| 4 | CPS 356 | Database Systems |
| 3 | CPS 362 | Computer Networking I |
| 40 total required credit hours in twelve (12) required courses for both Major and Minor | | |

Computer Science ELECTIVE Courses

| Credit Hours | Course Name and Number | Description |
|--|------------------------|--|
| 4 | CPS 206 | Web Programming I |
| 4 | CPS 306 | Web Programming II |
| 3 | CPS 406 | Selected Topics in Web Programming |
| 3 | CPS 214 | Advanced Topics in ICT |
| 3 | CPS 442 | Operating Systems II & Distributed Computing |
| 3 | CPS 449 | Selected Topics in Operating Systems |
| 4 | CPS 358 | Compilers |
| 3 | CPS 458 | Selected Topics in Compilers |
| 3 | CPS 459 | Selected Topics in Database Systems |
| 3 | CPS 462 | Computer Networking II |
| 3 | CPS 469 | Selected Topics in Computer Networking |
| 4 | CPS 371 | Artificial Intelligence (AI) |
| 3 | CPS 479 | Selected Topics in Artificial Intelligence (AI) |
| 3 | CPS 381 | Math-based Computing / Numerical Analysis I (MATLAB / SCILAB) |
| 3 | CPS 382 | Math-based Computing / Numerical Analysis II (MATLAB / SCILAB) |
| 3 | CPS 491 | Computer Graphics |
| 3 | CPS 497 | Selected Topics in Computer Graphics |
| 3 | CPS 499 | Selected Topics in Computer Science |
| 15 total required credit hours required for Computer Science Major | | |

III. Computer Science Minor Requirements

The aim of the Computer Science minor is to provide students with a broad overview of computer science theory, programming, and computing architectures in conjunction with their major in another course of study.

Students wishing to graduate from the University of The Gambia with a minor in Computer Science must complete a minimum of 120 credit hours including:

1. All general education requirements of the University of The Gambia, and
2. All departmental requirements of the Department of Science and Technology including introductions to Calculus (MTH101), Physics (PHY101), and Chemistry (CHM101),
3. All 40 credit hours of the twelve (12) Computer Science core courses as defined above.

IV. Requirements for Admission to the Major/Minor

Admission to the Computer Science major or minor requires the student be admitted to the Department of Science and Technology at the University of The Gambia and to have obtained at least a grade of 'C' in each of the following introductory courses in Computer Science: CPS111 (Intro. to ICT), CPS 101 (Computer Programming I), and CPS122 (Intro. to Computer Science).

V. Example Academic Calendar for CPS Major

Here is an example of when you might take CPS courses for the CPS Major.

NOTE: this does NOT include when you would take the rest of the courses required for a BSc in the Department of Science and Technology (e.g. MTH101, PHY101, CHM101, etc...)

Key: L.H. = Lecture Hours, T.H. = Tutorial Hours, P.H. = Practical Hours, C.H. = Credit Hours

| Year 1 | | | | | |
|------------------------|--|-------|-------|------|------|
| Course Code | Course Title | L. H. | T. H. | P.H. | C.H. |
| First Semester | | | | | |
| CPS 101 | Computer Programming I | 39 | | 39 | 4 |
| CPS 111 | Introduction to Information Communication Technology | 39 | - | - | 3 |
| Second Semester | | | | | |
| CPS 102 | Computer Programming II | 39 | | 39 | 4 |
| CPS 122 | Introduction to Computer Science | 39 | - | - | 3 |

| Year 2 | | | | | |
|------------------------|--|-------|-------|------|------|
| Course Code | Course Title | L. H. | T. H. | P.H. | C.H. |
| First Semester | | | | | |
| CPS 201 | Computer Logic and Discrete Structures | 39 | 13 | - | 3 |
| CPS 235 | Computer Architecture | 39 | 39 | - | 3 |
| Second Semester | | | | | |
| CPS 212 | Data Structures and Functional Programming | 39 | - | 39 | 4 |
| ELECTIVE | 200-level CPS Elective | | | | |

| Year 3 | | | | | |
|------------------------|---|-------|-------|------|------|
| Course Code | Course Title | L. H. | T. H. | P.H. | C.H. |
| First Semester | | | | | |
| CPS 321 | Theory of Computing I | 39 | 20 | - | 3 |
| CPS 341 | Operating Systems I & Systems Programming | 39 | 10 | - | 3 |
| ELECTIVE | 300-level CPS Elective | | | | |
| Second Semester | | | | | |
| CPS 356 | Database Systems | 39 | - | 39 | 4 |
| CPS 362 | Computer Networking I | 39 | 10 | - | 3 |
| ELECTIVE | 300-level CPS Elective | | | | |

| Year 4 | | | | | |
|------------------------|---|-------|-------|------|------|
| First Semester | | | | | |
| Course Code | Course Title | L. H. | T. H. | P.H. | C.H. |
| CPS 401 | Senior Research and Development Project | | | | 2.5 |
| ELECTIVE | 400-level CPS Elective | | | | |
| ELECTIVE | 400-level CPS Elective | | | | |
| Second Semester | | | | | |
| Course Code | Course Title | L. H. | T. H. | P.H. | C.H. |
| CPS 401 | Senior Research and Development Project | | | | 2.5 |
| CPS 422 | Theory of Computing II | 39 | 20 | - | 3 |
| ELECTIVE | 400-level CPS Elective | | | | |

VI. Course Descriptions

The University of The Gambia

Computer Science (CPS) Course Descriptions

CPS101: Computer Programming I

This course is an introduction to programming using the Java programming language. Topics include algorithms, language concepts, selection, repetition, functions, objects and classes, arrays, strings, and inheritance. Principles of software development and style are emphasized. The course assumes high school mathematics (no calculus) but no programming experience.

Prerequisites: None

Credit hours: 4

CPS102: Computer Programming II

Intermediate programming in a high-level language. Topics include program structure and organization, modules (classes), program development, proofs of program correctness, recursion, data structures and types (lists, stacks, queues, trees), object-oriented and functional programming, and analysis of algorithms. Java is the principal programming language. The course requires the design and implementation of several large programs.

Prerequisites: CPS101 or permission of the instructor

Credit hours: 4

CPS111: Introduction to Information Communication Technology (ICT)

This course is a practical introduction to the field of Information Communication Technology (ICT) focusing on using a computer, the Internet, and the Microsoft Office suite of applications. Topics include the history of computing, the parts of a computer and how they interact, using the Microsoft Windows operating system (startup/shutdown, file organization and manipulation, and basic system maintenance), basic authoring and formatting of documents in the Microsoft Word WYSIWYG (What You See Is What You Get) editor, data organization, manipulation, and graphing using the Microsoft Excel spreadsheet application, information organization and presentation using the Microsoft PowerPoint application, and using the Internet to find information. Possible additional topics include: an overview of various web-based utilities (Wikis, Blogger, etc...), and open source alternatives to commercial software (e.g. Linux, OpenOffice). No previous computing experience is required. A significant portion of this course will be taught in the computer lab.

Prerequisites: None

Credit hours: 3

CPS122: Introduction to Computer Science

This course is structured as a survey course intended to give students an introductory understanding of the various topics studied in the computer science major. Topics include the history of computing and computer science theory, computer architecture (structure, organization, and interconnection), number systems (binary, octal, and hexadecimal), binary math, computer logic, discrete systems, an overview of programming languages (including examples, how they are used, and the differences between them), compilers, operating systems, and computer networking. No previous computing experience is required.

Prerequisites: None

Credit hours: 3

CPS201: Computer Logic and Discrete Structures

Covers mathematical aspects of programming and computing. Topics include mathematical induction, logical proof, propositional and predicate calculus, combinatorics and discrete mathematics covering manipulation of sums, recurrence relations, and generating-function techniques, basic number theory, sets, functions, and relations; partially ordered sets, graphs, and algebraic structures.

Prerequisites: CPS101

Credit hours: 3

CPS206: Web Programming I

The World Wide Web is both a technology and a pervasive and powerful resource in our society and culture. To build functional and effective websites, students need technical and design skills as well as analytic skills for understanding who is using the web, in what ways they are using it, and for what purposes. In this course, students develop skills in all three of these areas through the use of technologies such as HTML, DHTML, XHTML, Cascading Stylesheets (CSS), and PHP. Students study how websites are deployed and used, usability issues on the web, user-centered design, and methods for visual layout and information architecture. The course requires the design and implementation of a website.

Prerequisites: None.

Credit hours: 4

CPS212: Data Structures and Functional Programming

An advanced programming course that emphasizes functional programming techniques and data structures. Programming topics include recursive and higher-order procedures, models of programming language evaluation and compilation, type systems, and polymorphism. Data structures and algorithms covered include graph algorithms, balanced trees, memory heaps, and garbage collection. Also covered are techniques for analyzing program performance and correctness. This course includes significant programming assignments.

Prerequisites: CPS102 or permission of the instructor

Credit hours: 4

CPS214: Advanced Topics in Information Communication Technology (ICT)

This course is a follow-on to CPS111 and will focus on advanced usage of the Microsoft Windows operating system, the Internet, and the Microsoft Office suite of applications. Topics include advanced administration and maintenance of the Microsoft Windows operating system (including managing users, troubleshooting, and networking), advanced authoring and formatting of documents in Microsoft Word (including themes, styles, and publishing to the web), advanced topics in Microsoft Excel (including functions, lookup tables and pivot tables), advanced usage of the Microsoft PowerPoint application (including animation, timing, and importing graphics, sounds, and videos), integration of the Microsoft Office suite of applications (including dynamic update of data across applications), and advanced Internet usage.

Prerequisites: CPS111 or permission of the instructor

Credit hours: 3

CPS235: Computer Architecture

An introduction to computer organization and architecture. Topics include representation of information, machine and assembly languages, processor organization, input/output devices, memory hierarchies, combinatorial and sequential circuits, data path and control unit design, and RISC pipelining.

Prerequisites: CPS201

Credit hours: 3

CPS306: Web Programming II

Web programming requires the cooperation of two machines: the one in front of the viewer (the client) and the one delivering the content (the server). CPS205 (Web Programming I) concentrates almost exclusively on the client side. The main emphasis in this class is learning about server side processing. Students begin by looking at interactions with databases, learning about querying both on paper and to a database via SQL, and then, through a succession of projects, learn how to apply this understanding to the creation of an interactive data-driven site via the use of an integrated web site development tool. Also considered are techniques to enhance security, privacy, and reliability, and ways of incorporating other programs. Design issues are emphasized. A major component of the course is the creation of a substantial database-driven web site.

Prerequisites: CPS101 and CPS205 or permission of the instructor

Credit hours: 4

CPS321: Theory of Computing I

An introduction to the modern theory of computing. Topics include automata theory, formal languages, and effective computability.

Prerequisites: CPS201

Credit hours: 3

CPS341: Operating Systems I & Systems Programming

An introduction to the logical design of systems programs, with emphasis on multiprogrammed operating systems. Topics include process synchronization, deadlock, memory management, input-output methods, information sharing, protection and security, and file systems. The impact of network and distributed computing environments on operating systems is also discussed.

Prerequisites: CPS102 and CPS235

Credit hours: 3

CPS356: Database Systems

An introduction to modern relational database systems. Concepts covered include storage structures, access methods, query languages (including SQL), query processing and optimization, transaction processing, information locking and deadlocks, and database design theory including data normalization. The course primarily covers the internals of database systems and includes programming assignments.

Prerequisites: CPS212

Credit hours: 4

CPS358: Compilers

An overview of the internal structure of modern compilers with emphasis on implementation techniques. Topics covered include lexical scanning, simple parsing techniques, symbol-table manipulation, type-checking routines, code generation, and simple optimizations. The course entails a compiler implementation project.

Prerequisites: CPS212 and CPS235

Credit hours: 4

CPS362: Computer Networking I

An overview of the history of networking including classical line-switched communication networks, point-process models for offered traffic, blocking and queuing analyses, stability, throughput, and delay of distributed algorithms for packet-switched transmission of data over local-area and wide-area nets, flow control and capacity assignment algorithms, and ATM networks.

Prerequisites: CPS235 and one class in Probability and Statistics or permission of the instructor.

Credit hours: 3

CPS371: Artificial Intelligence (AI)

A challenging introduction to the major subareas and current research directions in artificial intelligence. Topics include knowledge representation, heuristic search, problem solving, natural-language processing, game-playing, logic and deduction, planning, and machine learning. Students undertake a substantial software project.

Prerequisites: CPS102, CPS201, and CPS212

Credit hours: 3

CPS381: Math-based Computing / Numerical Analysis I (MATLAB / SCILAB)

This class will analyze and implement modern algorithms for solving problems in mathematics including systems of linear equations, systems of nonlinear equations, numerical optimization, and numerical solution of differential equations. This class will also include some discussion of implementing algorithms suitable for parallel computation. This class will utilize the MATLAB and/or SCILAB software systems.

Prerequisites: CPS101 and one course in Linear Algebra or permission from the instructor.

Credit hours: 4

CPS382: Math-based Computing / Numerical Analysis II (MATLAB / SCILAB)

TBD

Prerequisites: CPS381

Credit hours: 3

CPS401: Senior Research and Development Project

This course is taught over two (2) semesters for a total of five (5) credit hours. Students will work together in teams in a simulated "real-world" business environment to perform a significant research and development effort into a current topic in Computer Science. Students will develop and/or significantly contribute to a large-scale, open source software engineering effort. This class will introduce the students to both the business and open-source community requirements when working in the Computer Science sector. Topics covered may include performing market research and gathering of customer requirements, project scoping and accurate estimation of large development efforts, long-term software development using milestones and version numbering, bug tracking and release planning, software version and revision control, alpha→beta→gold→bugfix release cycles, determining level of success in meeting market needs, and responding to post-install customer support issues.

Prerequisites: CPS 212, CPS 321, and student must be in their final year or have received permission of instructor

Credit hours: 5 (total for both semesters)

CPS406: Selected Topics in Web Programming

A variety of advanced issues examining the architectures, tools, and techniques for building and managing large-scale distributed information systems on the World Wide Web. This class will be centered around extensive paper reading and discussion. Students will develop a term project with research content.

Prerequisites: CPS306 or permission of instructor

Credit hours: 3

CPS422: Theory of Computing II: Analysis of Algorithms

A variety of advanced topics including techniques used in the creation and analysis of algorithms, combinatorial algorithms, computational complexity, NP-completeness, and intractable problems.

Prerequisites: CPS201 and CPS341

Credit hours: 3

CPS442: Operating Systems II & Distributed Computing

This course focuses on practical issues in designing and implementing modern operating systems and distributed software. Topics include object-oriented software development methodologies and tools, distributed computing, fault-tolerant systems, and networked operating systems or databases. Students undertake a substantial software project.

Prerequisites: CPS341

Credit hours: 3

CPS449: Selected Topics in Operating Systems

A variety of advanced issues in operating systems emphasizing contemporary research in distributed systems. Topics may include communication mechanisms, consistency in distributed systems, fault-tolerance, knowledge and knowledge-based protocols, performance, scheduling, concurrency control, and authentication and security issues. This class will be centered around extensive paper reading and discussion. Students will develop a term project with research content.

Prerequisites: CPS442 or permission of instructor

Credit hours: 3

CPS458: Selected Topics in Compilers

A variety of advanced issues including compiler design for pipelined and parallel architectures. This class will be centered around extensive paper reading and discussion. Students will develop a term project with research content.

Prerequisites: CPS358 or permission of instructor.

Credit hours: 3

CPS459: Selected Topics in Database Systems

A variety of advanced issues including transaction management, query processing, and data mining. This class will be centered around extensive paper reading and discussion. Students will develop a term project with research content.

Prerequisites: CPS356 or permission from the instructor

Credit hours: 3

CPS462: Computer Networking II

Advanced topics in communication including wireless networks, cellular systems, medium access control, control of a mobile session and a mobile call, signaling in mobile networks, mobility management techniques, common air interfaces (e.g GSM), wireless data, satellite communication, ad hoc networks (e.g. Bluetooth), Internet Mobility, and Personal Communication Services (PCS).

Prerequisites: CPS362

Credit hours: 3

CPS469: Selected Topics in Computer Networking

A variety of advanced issues focusing on current trends in computer networking including wireless networks and high-bandwidth transfer, fault tolerance, and error control. This class will be centered around extensive paper reading and discussion. Students will develop a term project with research content.

Prerequisites: CPS462 or permission from the instructor

Credit hours: 3

CPS479: Selected Topics in Artificial Intelligence (AI)

A variety of advanced issues and current developments in Artificial intelligence (AI). This class will be centered around extensive paper reading and discussion. Students will develop a term project with research content.

Prerequisites: CPS371 or permission of instructor

Credit hours: 3

CPS491: Computer Graphics

An introduction to the principles of computer graphics in two and three dimensions. Topics include digital images, filtering and antialiasing, 2D and 3D affine geometry, ray tracing, perspective and 3D viewing, the graphics pipeline, curves and surfaces, and human visual perception. Homework assignments require programming.

Prerequisites: CPS102 and CPS212

Credit hours: 3

CPS497: Selected Topics in Computer Graphics

A variety of advanced issues and current developments in computer graphics including 3D transformations, the hardware graphics pipeline, advanced texturing and shading, visual perception and color science, rendering algorithms including global illumination, animation, user interfaces, visualization, and 3D surface modeling. This class will be centered around extensive paper reading and discussion. Students will develop a term project with research content.

Prerequisites: CPS491 or permission of the instructor

Credit hours: 3

CPS499: Selected Topics in Computer Science

A variety of advanced issues and current developments in the field of Computer Science. This class will be centered around extensive paper reading and discussion. Students will develop a term project with research content.

Prerequisites: permission of the instructor

Credit hours: 3