

Implementing the IT Fundamentals Knowledge Area

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ABSTRACT

The recently promulgated IT model curriculum contains IT fundamentals as one of its knowledge areas. It is intended to give students a broad understanding of (1) the IT profession and the skills that students must develop to become successful IT professionals and (2) the academic discipline of IT and its relationship to other disciplines. As currently defined, the IT fundamentals knowledge area requires 33 lecture hours to complete.

The model curriculum recommends that the material relevant to the IT fundamentals knowledge area be offered early in the curriculum, for example in an introduction to IT course; however, many institutions will have to include additional material in an introductory IT course. For example, the Introduction of IT course at Georgia Southern University is used to introduce students to the available second disciplines (an important part of the Georgia Southern IT curriculum aimed at providing students with in-depth knowledge of an IT application domain), some productivity tools, and SQL.

For many programs there may be too much material in an introductory IT course. This paper describes how Georgia Southern University resolved this dilemma.

Categories and Subject Descriptors

K.3.3 [Computer and Information Science Education]: Curriculum

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1. INTRODUCTION

The recently promulgated IT Model Curriculum, available at <http://sigite.acm.org/activities/curriculum/>, consists of 12 knowledge areas including IT fundamentals (ITF). ITF is intended to provide students with a set of foundation skills and provide an overview of the discipline of IT and its relationship to other computing disciplines. It is also intended to help students

understand the diverse contexts in which IT is used and the challenges inherent in the diffusion of innovative technology. Given its foundational nature, it will not come as a surprise that the model curriculum recommends that ITF is covered early in a student's program of study, and it seems most logical that this knowledge area be covered in an introductory course in a baccalaureate program in IT.

The IT Model curriculum recommends a minimum coverage of 33 lecture hours for the ITF knowledge area; however, a typical 3-credit semester course gives an instructor, at most, 45 lecture hours, and many programs will have to include additional material in an introductory course. For example, an important element of the IT program at Georgia Southern University is the inclusion of second disciplines, coherent sets of 7 courses in an IT application area, such as electronic broadcasting, law enforcement, music technology, and supply chain management ([5], [6]). Since students must begin introductory courses in their second discipline relatively early in their academic program, it is important that they be exposed to the range of second disciplines available to them early, and the most appropriate place to do this is in the introductory IT course. Also, students enrolling in the introductory IT course at Georgia Southern are not expected to have taken a computer literacy course beforehand, and it has become clear that many are weak in the use of spreadsheets. Since the program strongly believes that IT graduates can be expected to be conversant with basic productivity tools, including spreadsheets, the course must cover the basics of spreadsheet application. Finally, the introductory IT course must also provide a basic coverage of SQL, because the web design course, which covers n-tier architectures and requires a basic knowledge of SQL, is taught before the data management course in which SQL is normally presented.

While the additional material that has to be covered in an introductory IT course is likely to differ between institutions, it is likely that many, if not all, IT programs will have to cover some additional material. Given that ITF already requires 33 lecture hours, considerable pressure is placed upon instructors in introductory IT courses to cover both the ITF material and whatever additional material needs to be included.

The intent of this paper is to describe how this particular dilemma was resolved at Georgia Southern University. Section 2 provides more details about the IT fundamentals knowledge area, while section 3 discusses the introduction to IT course offered at Georgia Southern University. Section 4 concludes.

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2. THE IT FUNDAMENTALS KNOWLEDGE AREA

The IT Model Curriculum follows the example set by the Computer Science model curriculum (<http://www.acm.org/education/curricula.html>) and distinguishes between a number of knowledge areas, each consisting of a number of knowledge units. Knowledge units are themselves composed of topics and learning outcomes. For reasons explained in ([4]), the IT model curriculum differs from the computer science model curriculum in that it distinguishes between core learning outcomes, which every graduate from an IT program is expected to achieve, and elective learning outcomes, which only graduates specializing in this area are expected to achieve. Given the foundational nature of ITF, it should come as no surprise that ITF only has core learning outcomes associated with it.

Below are listed the knowledge units and the core learning outcomes associated with each. The number behind each knowledge unit is the minimum recommended coverage expressed in lecture hours.

ITF1. Pervasive themes in IT (17)

1. Describe the components of IT systems and their interrelationships.
2. Describe how complexity occurs in IT.
3. Recognize that an IT professional must know how to manage complexity.
4. List examples of tools and methods used in IT for managing complexity.
5. Describe the role of the IT professional as the user advocate.
6. Explain why life-long learning and continued professional development is critical for an IT professional.
7. Explain why adaptability and interpersonal skills are important to an IT professional.
8. Distinguish between data and information, and describe the interrelationship.
9. Describe the importance of data and information in IT.
10. Explain why the mastery of information and communication technologies is important to an IT professional.
11. Explain why the IAS perspective needs to pervade all aspects of IT.

ITF2. Organizational Issues (6)

1. Describe the elements of a feasible IT application.
2. Identify the extent and activities involved in an IT application.
3. Understand the requirements of the business processes.
4. Outline the project management processes.
5. List the integration processes.

ITF3. History of IT (3)

1. Outline the history of computing technology.
2. Describe significant impacts of computing on society.
3. Describe significant changes in human-computer interaction.
4. Outline the history of the Internet.

ITF4. IT and its related and informing disciplines (3)

1. Define "Information Technology."
2. Describe the relationship between IT and other computing disciplines.

3. Describe the relationship between IT and non-computing disciplines.
4. Explain why mathematics and statistics are important in IT.

ITF5. Application domains (2)

1. Describe the application of IT in non-computing disciplines.
2. Describe how IT has impacted almost all aspects of modern living.
3. Describe ways and extents in which IT has changed the interaction and communication in our society.
4. Describe how IT has impacted the globalization of world economy, culture, political systems, health, security, warfare, etc.

ITF6. Application of math and statistics to IT (2)

1. Recognize the foundation of IT is built upon the various aspects of mathematics.
2. Understand the number systems used in computation.
3. Explain data representation and encoding systems.
4. Describe the current encryption methods and their limitations.
5. Describe the pervasive usage of mathematical concepts, such as functions, relations, sets as well as basic logic used in programming.
6. Recognize the value of probability and statistics.
7. Describe the basic data analysis concepts and methods used in IT applications.

The total minimum recommended coverage thus is 33 lecture hours.

3. THE INTRODUCTION TO IT COURSE AT GEORGIA SOUTHERN UNIVERSITY

3.1 Course Outcomes

The introduction to IT course (IT 1130) offered in the Department of IT at Georgia Southern University is designed to introduce students to IT as a discipline and cover some productivity tools, namely Excel and Access. In line with all other IT courses at Georgia Southern University, IT 1130 was formulated through a set of explicit learning outcomes. The learning outcomes for IT 1130 are

1. Demonstrate a basic understanding of the field of IT, including the ability to
 - i. Define the term "Information Technology";
 - ii. Recognize the disciplines that have contributed to the emergence of IT, namely computer science, information systems, and computer engineering;
 - iii. Identify areas in which IT has significantly impacted individuals, organizations and/or societies.
2. Demonstrate an understanding of basic information technology software applications, including the ability to
 - i. Using a given specification, create a simple database;
 - ii. Use SQL for simple queries;
 - iii. Use an office productivity suite.

The overlap between Objective 1 and the ITF Knowledge Area is significant; however, due to Objective 2, the introductory IT course at Georgia Southern must cover significant additional material not specified in the IT fundamentals knowledge area.

3.2 Course Outline and its Mapping to the IT Fundamentals Knowledge Area

The Introduction to IT course at Georgia Southern consists of 45 lecture hours. Teaching productivity tools, Learning Outcome 2 listed in Section 3.1, accounts for roughly 9 hours of instruction. Exams conducted during the semester account for 3 hours of instruction. This leaves 33 lecture hours to cover the remaining topics for IT 1130 relating to Learning Outcome 1 listed in Section 3.1. Table 1 provides a breakdown of the topics covered in the remaining 33 hours of instruction, the number of lecture hours spent on that topic, as well as the learning outcome in the IT fundamentals knowledge area of the model curriculum to which the topic corresponds.

TABLE 1: IT 1130 Topics and ITF Learning Outcomes

IT 1130 Topic	Objective	# Hours
1 Define IT	ITF4.1	1
2 Data and Information	ITF1.8 ITF1.9	1
3 Components of IT Systems <ul style="list-style-type: none"> Hardware Software Networks User 	ITF1.1	8.5
4 Core Technologies <ul style="list-style-type: none"> Data Management Networking Web Systems SAD Programming HCI Specializations in BSIT 	ITF1.10 ITF2.1 ITF2.2 ITF2.3 ITF2.4 ITF2.5	8.5
5 Related Disciplines	ITF4.2 ITF4.3 ITF4.4	2
6 Application Domains (Second Disciplines in BSIT)	ITF5.1 ITF5.2 ITF5.3 ITF 5.4 ITF 3.2	7
7 History of IT	ITF3.1 ITF3.4	1
8 Viruses, Crime, Law, Ethics, Privacy & Security	ITF1.11 ITF 3.2	3
9 IT as a Profession	ITF1.5 ITF1.6 ITF1.7 ITF1.10	1
TOTAL		33

Table 2 compares the number of hours of instruction in the IT 1130 course for each of the knowledge units in the IT fundamentals area to the minimum recommended number of lecture hours listed in the model curriculum. The next section, Section 3.3, discusses the discrepancies between the recommended number of hours and the actual number of hours taught.

TABLE 2: Comparison of IT 1130 to ITF Knowledge Area

ITF Knowledge Units	ITF Recommended	IT 1130	Knowledge Units Not Covered
ITF1	17	14	1.2, 1.3, 1.4
ITF2	6	7.5	
ITF3	3	2	3.3
ITF4	3	3	
ITF5	2	6.5	
ITF6	2	Not Covered	6.1 – 6.7
TOTAL	33	33	

3.3 Some Observations

Table 2 illustrates several noteworthy differences between the IT 1130 course at Georgia Southern University and the knowledge units in the ITF knowledge area.

1. A discrepancy exists between the minimum number of hours recommended for ITF1 (pervasive themes in IT) and the number of hours taught in IT 1130. The 3 hour discrepancy can be attributed to the lack of coverage in IT 1130 of outcomes ITF1.2 – 4. Thus, IT 1130 provides no explicit coverage of the reasons for the emergence of complexity in IT, the need for IT professionals to handle complexity, and the tools and techniques available to an IT professional in IT1130. Instead, the IT program at Georgia Southern covers complexity-related issues in a number of courses throughout the curriculum. For example, some complexity-related issues are discussed in a two-course sequence of Java programming courses. Standards are discussed in a number of courses throughout the curriculum, including a data communication course and a web design course in which students learn how to implement n-tier architectures. Finally, complexity related issues are also covered in a capstone course on IT issues and management. Since the need to manage complexity is identified in the IT model curriculum as a pervasive theme, this is a reasonable alternative to cover this issue.
2. The IT 1130 course devotes more lecture hours than the minimum recommendation to ITF2 (organizational issues) and ITF5 (application domains). As the recommendation is a minimum, this is not problematic; however, it is worth noting that the explanation for these discrepancies relates directly to the structure of the IT major at Georgia Southern University.

IT majors are expected to take a number of core courses, including courses in programming; web design; software acquisition, implementation and integration; networking;

systems analysis and design; data management; and project management. In addition, IT majors specialize in either knowledge management and it integration, systems development and support, telecommunications and network administration, or web and multimedia foundations. It is useful to students starting out on their academic program in IT to receive information on the structure of the core of the program, the courses that it consists of and how they relate to each other, and on the different specializations available to them. Since, for most IT majors, IT 1130 is the first course in the program, it is the logical place to meet this aim. Clearly, a full discussion of the structure of the program covers more than just data management (ITF1.10), a broad overview of IT applications (ITF2.1) and their development (ITF2.2), systems analysis (ITF2.3), project management (ITF2.4), and IT integration (ITF2.5). This explains why IT 1130 devotes 1.5 more hours than the recommended minimum 6.

Another important element of the IT program at Georgia Southern is the inclusion of second disciplines. One of the explicit program outcomes of the BS in IT program at Georgia Southern is that, on graduation, graduates will be able “to demonstrate sufficient understanding of an application domain to be able to develop IT applications suitable for that application domain.” This outcome was included at the recommendation of industry representatives who were consulted when the IT program was designed ([5]). For students to develop this ability, they must be exposed to an IT application domain, and the BS IT program at Georgia Southern therefore contains so-called second disciplines. Second disciplines are coherent sets of 7 3-credit courses in potential IT application domains, such as electronic broadcasting, law enforcement, music technology, or supply chain management. Students typically start taking courses in their second discipline early in their program of study (the standard program of study suggests that students take their first second discipline course in the first semester of their sophomore year). It is therefore important that students be exposed to the different second disciplines available to them early, and IT 1130 is the logical place to do so. One fortunate side effect of the need to introduce a second discipline is that it gives the program an excellent opportunity to make students aware of the broad range of areas in which IT can be applied and, hence, cover ITF5 (application domains); however, since the number of second disciplines is large (currently, 26), adequate coverage requires 4.5 hours more than the minimum recommend coverage for ITF 5 (application domains)

3. One lecture hour is missing in ITF3 (history of IT) due to lack of coverage in the IT 1130 course of significant changes in HCI (ITF3.3). Some material relevant to this topic is introduced in other courses that students tend to take early in their program of study, such as the Introductory Java course and the introductory web design course. For example, the introductory web design course includes among its course objectives that students develop the ability to design Web pages in accordance with good design principles using appropriate styles and formats and the ability to design Web pages that are ADA compliant. Material relevant to both objectives allows us to expand on HCI design principles and

place these in a historical context. Moreover, students are advised to take the introductory web design course in the semester following the one in which they take IT 1130, and they are therefore likely to be exposed to material relevant to ITF3.3 early in their program of study.

4. The final discrepancy lies in the coverage of the learning outcomes corresponding to the ITF6 (application of math and statistics to IT) in the IT 1130 course; however, the material related to this knowledge unit is covered in two courses that students are again advised to take early in their program of study. One course is a course in discrete mathematics, designed specifically for IT majors. It includes among its course objectives the ability to explain the importance of discrete mathematics in computer science and information technology and provides in-depth coverage of functions, sets, basic propositional logic, and algorithm design. Finally, all students enrolled in the IT major take a statistics course, which covers probability.

3.4 Support Material

Since the ITF knowledge area is relatively new, no single textbook covers all relevant material. We therefore use a variety of sources to support the course.

First, we use *Excel 2003* ([8]) and *Access 2003* ([7]) to support the teaching of spreadsheets and SQL (IT 1130 course outcomes 2i-2iii identified in section 3.1).

Second, to support the teaching of Topics 3 (components of IT systems), 4 (core technologies) and 7 (history of IT), we use *Discovering Computers 2005* ([9]). While the textbook provides a reasonable coverage of some of the subtopics discussed, it does not sufficiently stress the importance of the users and the importance of HCI in systems development, and we, therefore, emphasize this issue throughout the course. We discussed the way in which we cover these topics in Points 2 and 3 in section 3.3.

Third, for topics 6 (Application Domains), 8 (Viruses, Crime, Law, Ethics, Privacy and Security) and 9 (IT as a profession), we use *Computers in Our World* ([3]); however, we do not rely solely on the textbook for our coverage of topic 6. Again, we discussed this in Point 2 in section 3.3.

Finally, to support Topics 1 (define IT), 2 (data and information), and 5 (IT and its related disciplines), students are given material written specifically for the course. Also, we invite representatives from computer science and information systems to lecture on their specific disciplines and follow this up with a lecture on computer engineering and a discussion on the relationship between all four disciplines.

Table 3 lists the core learning outcomes for each of the ITF knowledge units and maps them to the material in the IT 1130 course used to achieve that outcome. The material comes either from *Discovering Computers 2005* ([9]) (DC), *Computers in Our World* ([3]) (CIOW), or material written specifically for the course (supplemental material) and/or lectures/discussions led by faculty members from other related departments.

TABLE 3: Course Materials Used in IT 1130 to Achieve ITF Learning Outcomes

ITF Knowledge Units	Learning Outcomes	Material
ITF 1	1	DC Chapters 3-9
	2-4	Not covered
	5-7	DC Chapters 12 & 15, CIOW Chapters 8 & 9, Supplemental Materials
	8.9	DC Chapter 10, Supplemental Materials
	10	DC Chapters 2, 9, 10,12, 13, Supplemental Materials
	11	CIOW Chapters 7-9
ITF2	1-5	DC Chapters 2, 9, 10, 12, 13. Supplemental Materials
ITF3	1	DC Timeline between Chapters 1 and 2, Chapter 2
	2	CIOW Chapters 1 - 9
	3	Not covered
	4	DC Timeline between Chapters 1 and 2, Chapter 2
ITF 4	1-4	Supplemental Materials, Lecture and Class Discussion led by CS, IS and IT representatives
ITF5	1-4	CIOW Chapters 1 – 9
ITF6	1-7	Not covered

*Discovering Computers = DC, Computers in Our World = CIOW

4. CONCLUSIONS

The IT Fundamentals knowledge area in the IT model curriculum is of central importance to the design of an introductory IT course; however, since institutions will have to include additional materials in their introductory IT courses, depending on the nature of their program, the minimum requirement of 33 lecture hours to cover this material is likely to lead to problems. This paper presents the experience with an introductory IT course at Georgia

Southern University, IT1130. In general, we believe that, despite the need to include additional material in IT1130, we are able to cover most of the knowledge units in the IT fundamentals knowledge area. We are confident that those knowledge units not covered in IT1130 are covered in other courses that students are advised to take early in their programs of study. Finally, despite the fact that the IT fundamentals knowledge area is new and that no textbooks cover all the knowledge units within the area, we have been able to identify a set of textbooks that, jointly, cover most of the material; however, we provide a relatively small amount of additional material, and the textbooks we identified do not always cover the material at the appropriate level. Therefore, support materials specifically for the IT fundamentals knowledge area need to be developed. Whether this is best provided in the form of a textbook, or, more dynamically, as a set of online learning objects ([1], [2]) is a question open to debate.

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