

Information Processing – Administrative Data Processing

The First Courses at KTH and SU, 1966-67

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Abstract: A three semester, 60-credit course package in the topic of Administrative Data Processing (ADP), offered in 1966 at Stockholm University (SU) and the Royal Institute of Technology (KTH) is described. The package had an information systems engineering orientation. The first semester focused on datalogical topics, while the second semester focused on the infological topics. The third semester aimed to deepen the students' knowledge in different parts of ADP and at writing a bachelor thesis. The concluding section of this paper discusses various aspects of the department's first course effort. The course package led to a concretisation of our discipline and gave our discipline an identity. Our education seemed modern, "just in time", and well adapted to practical needs. The course package formed the first concrete activity of a group of young teachers and researchers. In a forty-year perspective, these people have further developed the department and the topic to an internationally well-reputed body of knowledge and research. The department has produced more than thirty professors and more than one hundred doctoral degrees.

Keywords: Administrative data processing, information systems, university education, datalogy, infology

1. Introduction

The situation in Sweden in mid 1960s regarding computers and education can be summarised as follows¹. In total, more than 200 computers existed in the public sector and in business and industry. This corresponded to an investment of more than 500 million Swedish crowns. IBM, having a 70-75% market share, dominated the market. SAAB, CDC, ICL, Siemens, and other vendor companies shared the remaining 25-30%. Practically all computers were large², centralised,

¹ This section is based primarily on the author's personal memories. Some information can also be found in [13].

² For instance IBM 7070, 1401, CDC 3200, Univac III, RCA 301, 501, Saab D21, ICL 1901, Burroughs B35600, etc.

and operated in a “batch processing” mode. Communication of data using telephone lines was unusual (and slow, about 300 bps).

The computing industry employed between 8,000 and 10,000 persons with jobs such as programmers, system analysts and designers, administrators, salespersons, and technicians. These professionals had no academic degrees in computer-oriented topics such as computer science or information processing. Such education at universities simply did not exist. Several of them had a basic university education as mathematicians, statisticians, engineers, or economists. They acquired their knowledge and skills in computers and programming by courses offered by the computer vendors. IBM, in particular, had a considerable activity in training of their customers’ personnel in programming as well as in systems development and planning. People with an academic degree were often given a full year of full-time training at IBM before being placed to work as salespersons or system analysts.

Swedish university authorities became concerned with higher education in the field of computing. No university discipline in computing or in information systems existed at this time. What did exist were shorter programmes and courses in computer technology, programming, and systems planning and work, normally as part of other educational programmes. For instance, shorter courses in computer technology were normally part of electrical engineering programs, courses in programming part of programs in mathematics or statistics, and courses in systems planning and work were part of programs related to economics and business administration. Business schools at the university of Gothenburg and Lund were particularly active in integrating systems development knowledge in their MBA programs. However, there was no university degree in the disciplines computer science, information processing, or systems development. On the labour market, however, there was a definite need for specialists with these computer and systems development skills.

On April 3, 1963, the chancellor of Swedish universities appointed a commission³ with a mission to investigate the issue of “Academic education on the topic of administrative data processing”, and to come up with suggestions for action. The committee issued a report in November, 1964 [12]. The report observed the great need for increasing the number of qualified professionals in the administrative computing business, as well as the need for advanced research. It estimated the annual need of academically trained professionals in administrative data processing (economists as well as engineers) to about 400-500. The report recommended a new academic discipline named “Administrative Data Processing”, including corresponding chairs, to be established from the academic year 1965-1966 at three universities (Gothenburg, Lund, and Stockholm). The report also suggested a preliminary course outline for the first three semesters.

The Swedish government decided to establish a joint chair at Stockholm University and the Royal Institute of Technology in 1965. We can best describe the focus of the discipline by the title of the professor’s chair: “Information Processing with a specialisation towards methods for administrative data

³ G. Hävermark (chair), O. Dopping (secr.), C-E Fröberg, B-G Andrén, C. Kihlstedt, B. Tell, C. Österberg, and W. Goldberg.

processing”. This formal and very long name was later in everyday use replaced by the simpler “Administrativ Databehandling” (ADB), also called Administrative Data Processing (ADP). The content of the teaching in ADB resembled at that time to some extent what some universities in the USA and Europe taught in the discipline of “Information Systems”.

2. The First Courses

The first three-semester course structure at the department followed essentially the suggestions given in [12]. Primarily the author together with Börje Langefors designed the three-semester program. The first semester included topics such as computer systems and components, low-level programming languages, high-level programming languages, and performance analysis. The second semester focussed on methods for systems analysis and design, as well as issues related to administration, planning, and management in organisations. The second semester also included a substantial system design exercise; students had to develop and describe an information system for a business organisation according to requirements specified by the department. Students had to take a course on operating systems as well. In the third semester, students could take additional specialised courses; however, a large part of it was devoted to writing a bachelor-level thesis.

2.1 The B-level Package

The first regular⁴ course offered by the department was a 20-credit course for one semester starting in the fall of 1966. We called it a B-level course. The normal prerequisite for admission to the 20-credit B-course was a Swedish high-school degree including mathematics at least corresponding to the level taught in the high-school specialisation towards social sciences. Other backgrounds were permitted if accepted by the university authorities.

For a bachelor degree (Fil. Kand.) students had to complete 120 credits. A typical combination of courses would be 40 credits of information systems courses combined with 80 credits in other disciplines such as mathematics, statistics, business administration, languages, or arts. At that time, no particular 120-credit “study programs” such as “DSV-linjen” (the study program in Computer and Systems Sciences) or “Systemvetenskapliga linjen” (the study program in Applied Systems Sciences) existed.

Although the topic ADB was taught face-to-face at the Royal Institute of Technology (KTH), most students registered at Stockholm University. It frequently happened however, that students of KTH took some of our courses, as

⁴ A regular course is a course formally offered by the university such that it can be included in the study programme of a student for a degree. In this text we use a direct translation to English of various concepts then used by the department in order not to change the “flavour” of the computer “era” of the late sixties.

optional courses. Some of our early assistants, recruited in the spring of 1967, were actually KTH-graduates.

Students quite well appreciated the courses. The B-level courses offered during the late 1960s had an attendance of 400 to 500 students. I do not remember other limits of the number of attendees than lecture hall space. There were surprisingly many female students, perhaps more than 30%. Many students had already 60 to 80 credits in a number of other university disciplines. They were interested in doing the ADB-course as they, rightfully, expected to find jobs related to this new discipline. Many students had background studies in disciplines such as mathematics, statistics, and business administration. Information Systems was a topic for the future, they felt.

The B-level package included four parts, five credits each. It totalled 102 hours of lectures, and 62 class hours of exercises plus, of course, student's individual and/or group work and homework. This implied roughly 8-10 contact hours per week. Appendix A shows the four-course package⁵ with the literature required for delivery of those courses and the examination summary students had to complete.

2.2 The AB-level Course Package

The B-level course package of 20 credits was followed in the spring semester of 1967 by the next level package of 20 credits, the AB-level course package. However, not all B-level students continued on the next level – perhaps only about one hundred of them. As we will see, the AB-level courses focussed on information systems theory, IT in organisations, computing system analysis and design, and on a large case study.

This package of four parts consisted of 88 hours of lectures and 28 hours of guided exercises. It also included a large assignment (a case study) for group work. Appendix B shows the four-course package with the literature required for delivery of those courses and the examination summary students had to complete.

2.3 Higher Level Education

The AB-level package was followed in the fall of 1967 by a C-level package of 20 credits. The C package contained a number of courses on Information Systems Theory (advanced), IS and organisations, Real-Time systems, Databases and Database Management systems, Simulation and the Programming Language Simula, and the like. The main task for students of the C-level course was, however, to write a bachelors thesis that awarded them 10 credits. In the spring of 1968, D-level courses followed the C-level courses; doctoral (Ph.D.) candidates primarily studied D-level courses.

⁵ The course descriptions of Appendices A and B are based on old, non-published administrative material at the department of ADB at KTH and SU in 1966 and 1967.

3. In Retrospect - Analysis and Discussion

I do not claim that the courses described above were the first courses, related to computing, taught at Swedish universities. However, I do claim that the course package described is the first comprehensive, academic “program” in Sweden for educating and training information systems analysts and designers. In our case, the package formed the basis for a new university topic “Information processing, specialising in methods for administrative data processing”. We now offer additional comments on the course package, the topic, as well as on the department.

3.1 Our Discipline

The contents of the above three-semester course package included what was believed, at that time, to be a minimum of necessary, systematic knowledge for designing and building computer based information systems to support operative as well as directive tasks in business and in organisations. The course structure was, therefore, rather like a *part* of an educational programme created for educating professionals for a particular job speciality – system analysts and designers. Clearly, it included topics which have to do with computer hardware, programming, management, and organisations, but which did not belong to the *core* of the discipline. Our experience tells that most of our students, majoring in our topic towards a bachelor degree, had complementary education in topics such as mathematics, statistics, or business administration.

What was the core of our topic, “Administrative Data Processing” (ADP)? At this stage, our topic was not exactly defined more than it had to do with essential knowledge needed for development and design of information systems. Furthermore, the persons responsible for designing the first course structure were themselves primarily “engineers” with experience of systems development, which gave the courses a practical and an engineering oriented flavour. Several years later Lange fors wrote an article in the magazine of SSI [11] (the Swedish Society for Information Processing, then the representative of IFIP in Sweden) where he argued for considering our topic as consisting of two main parts. One part was concerned with analysis of organisations and their information needs. The other part was concerned with designing an information system, based on computers as well as on humans, who implemented those requirements. He called these parts the “infological” and the “datalogical” parts of ADP. Programming was not seen as a core part of the datalogical part. The core of the datalogical part was rather the technical design of a software system, similar to what we call “software engineering” today. On the other hand, every academic program to educate system developers should contain, of course, also knowledge of computer hardware and of programming. Every ADP student should be able to develop a computer program in a machine level language as well as in higher-level languages.

A substantial part of the early core of our discipline, was contained in the book ”Theoretical Analysis of Information Systems” [9]. Students used this

internationally well-reputed book mainly in second semester studies. During the seventies it became a “bible” for most academic “information system” courses and researchers in Sweden. Another book of substantial impact on the discipline was “System för Företagsstyrning (Systems for Enterprise Control)” [10]. Datalogical parts of the discipline Information Systems were to a large extent reflected in the textbook “Data Processing Techniques” [3], and to a certain extent also in the textbook “An Introduction to Operating Systems” [4]. Another textbook that had an impact on our department’s first semester courses in 1966-67, and to some extent also on the technical parts of our discipline, was Olle Dopping’s “Computers and Data Processing” [8].

3.2 Students’ Reaction

Students’ reaction to our course programme was very positive. After a few years, more than 400 students did annually register for the B-level package. The AB-level package attracted annually more than 100 students. About 25 of them continued to the C-level and the writing of a Bachelors thesis. Computer based information systems were now being introduced in practically all kinds of business. Our education seemed modern, “just in time”, and well adapted to practical needs. Students, having passed the AB-level, had few problems to find a job as systems developers or programmers. Fortunately, also the business climate was very dynamic and favourable around the 1960s and the 1970s. Looking back at our first B and AB-level courses, I have no particular memories of many students quitting their education before completing a course. Perhaps this was the effect of our “quizzing approach”⁶ to examination, which tended to “drag most students along” towards concrete results.

3.3 Was the Department’s Education and Development Successful?

While we can answer this question, in the author’s opinion, by a definite yes, the articulation of the answer can fill a whole book. Recently, the department celebrated its 40th anniversary. A book of more than 400 pages, presenting historical annotations of various kinds, was published [5]. It is difficult to evaluate the courses as such, but we can confirm that the education started in 1966 gave birth to an impressive development in Sweden. After a few years, a similar course structure was adopted at other universities, for instance in Lund, Gothenburg, and Uppsala. Many graduates of ADP were hired in qualified positions in business and industry. Luckily, some students also remained at the department as teachers and doctoral candidates. They later became deeply involved in developing the department as well as the topic and with helping other universities in starting up ADP education. They also became active in writing and publishing new textbooks for different parts of the topic. The department and its staff was also heavily engaged in supporting the public sector of Sweden, as well

⁶ See section Examination on the B-level in appendix A. The quizzing approach was regrettfully discontinued in the early 70-ties, due to large manpower requirements for carrying it out when the student numbers grew larger.

as Swedish business with vocational training based on parts of the course package above. Some of the department's staff later started companies, for instance ENEA⁷, and research institutes such as V and SISU⁸. Many staff members became recognised professionals in the public as well as in the private sector. The department can proudly point to more than thirty persons that have had their basic education at the department and that have been appointed university professors in Sweden or elsewhere. The university awarded more than 100 doctoral (Ph.D.) degrees and about 100 Licentiate degrees. The current (2007) number of registered students per year is more than 1500.

The course structure has broadened considerably but it is fair to say that the first courses formed the basis for the first three-year academic programme in Sweden, the “Applied Systems Sciences” program (Systemvetenskapliga linjen) established in 1977. In 1993, the department started a four-year programme in “Computer and Systems Sciences”. Other programmes started in the 2000s are, for instance, the four-year ICT and Communication Science Programme (2002). It is, however, beyond the scope of this paper to give a fuller account of the department's recent activities and course programmes. The interested reader is directed to the anniversary book [5]. In 1989, the department changed its name to Computer and Systems Science (Data och Systemvetenskap – DSV) in order to better characterise its essential orientation.

3.4 International Outlook

In a Nordic perspective, the course package launched at KTH/SU in 1966-67 was one of the first, if not the first, in the Nordic countries. The situation in Denmark could be compared to what existed in Sweden 1965, data processing courses were integrated in business schools as parts of programs in management and administration.

On the European scene, some countries were moving fast ahead. Professor's chairs in business data processing had been established in Germany, in Switzerland, and in the Netherlands. The author has, however, no information about university programs developed at this time, similar to the one reported above. On the other hand, most western European countries were well ahead in scientific computing and in engineering computing as well.

As can be expected, the USA was the leading star in computing as well as in academic education in computing. Already in 1962, the Curriculum Committee on Computer Science (C³S) was formed under the leadership of William F. Atchison. This committee presented preliminary recommendations for an undergraduate program in computer science in 1965 [1]. We should note that at this time already about twenty universities in the U.S. were offering bachelor

⁷ ENEA is a large Swedish software house.

⁸ These institutes were foundations founded by a number of supporting Swedish organisations and companies. Institute V is oriented towards Business Administration and Development and SISU (the Swedish Institute of Systems Development) was oriented towards Information Systems Development.

programs in computer science or a similar topic, and about thirty were offering master programs. More than ten universities were offering doctoral programs.

What was the preliminary recommendation of C³S compared to our course package above? Firstly, the topic was different. It had a mathematics oriented, theoretical content, designed primarily to educate future computer and software scientists and researchers. Secondly, it suggested a full three-year program with all courses defined to achieve a bachelor degree. The computer science program was designed by academics for the education of academics. The C³S curriculum proposal became quickly disseminated to universities around the world. The well-known Curriculum 68 [2] followed it up.

What happened in the information systems area in the U.S.? We know little about the later part of the 1960s. In the early 1970s, ACM formed a subcommittee called the ACM Curriculum Committee on Computer Education for Management (C³EM); J. Daniel Couger was its leader. Recommendations for a four-year undergraduate program aiming at the master level in information systems were published in 1973 [6]. This program has many similarities with the course package of this paper; it also permitted different orientations such as organisational or technological. These orientations are similar to the infological and datalogical realms discussed above. It is noteworthy that these recommendations did put a comparatively heavy emphasis also on knowledge in topics such as mathematics, logic, statistics, and operations research. These topics were not included in our course package. We could only hope that students did combine our ADP-courses with relevant courses in other formal topics. Unfortunately, courses in other disciplines were not, at that time, adopted for combined use together with ADP. The C³EM recommendations were later, during the 1990s, refined in a collaborative curriculum effort of the ACM, AIS and AITP (formerly DPMA), called IS'97 [7].

3.5 How Did the Topic Develop in Sweden?

Langefors' associates and doctoral students, many of whom later became professors transferred the topic of information processing – ADP – to other universities in Sweden. It is beyond the ambitions of this paper to analyse the diffusion of the topic in Sweden. This issue would need a paper, or even a book, itself. However, a very simplistic view of what has happened is that the topic has split in two parts. One part is mainly concerned with the “infological” part of the topic as described above. A majority of university departments in the former topic of ADP have this business and social science orientation. They call the topic “informatik”. Another set of departments are concerned with both the infological and the datalogical realms but with a more pronounced engineering orientation. These departments call the topic “computer and systems science” or “information systems”. What seems to differ between these two is not so much what courses are being offered but rather the basic valuations and attitudes of the staff. We can also say that the engineering oriented departments pay greater attention in their teaching to formal topics such as mathematics, logic, statistics, and formal methods in general.

4. Conclusions

The three-semester course package in information processing (administrative data processing) was at that time fully in par with, or even ahead of, other university programs elsewhere in the world. The course package supported the development of and gave identity to a university department that eventually has developed into a significant and influential educational and research entity in Sweden.

References

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Appendix A

B-Level Package

B1 Introduction to automatic data processing (28 hours⁹ lectures, 2 hours exercises)

It included topics such as

- Concepts of “information”; information needs and requirements in different organisations; formulation of problems, algorithms, flow-charts, programming.
- From algorithms in a problem-oriented language to (low-level) computer programs, including the binary number system, compiling, diagnostics, object code, components of a computer system.
- Data transports, secondary storage units, input/output, data communication.
- Operating systems, multiprogramming, multiple access; economical considerations of programming work.
- Technical and scientific applications (batch processing, multiple access processing).
- Administrative data processing applications (batch processing, real-time processing).
- Process control, industrial real-time systems.
- Information systems theory; data processing system development, stages of a systems development process (life-cycle).
- Study visit to a computer centre

B2 Introduction to programming (20 hours lectures, 10 hours exercises)

This part included lectures on topics

- Algorithms and flowcharts, including proof of algorithms.
- The syntax of the problem oriented language Algol 60.
- Data structures and their representation in a computer memory.
- Program structures, including procedures and blocks in Algol.
- Input/Output of data, including Knuth’s proposal for input/output in Algol.
- Exercises involved algorithms, flowcharts, writing of programs in Algol, transformation of program to low-level code, etc. All students had also an individual assignment of completing a larger computer program including compiling and testing it (in batch mode) on a Control Data 3200 computer.

B3 Programming of a data processing problem and executing it on a computer

(lectures 34 hours, exercises 40 hours)

This part included lectures on topics

- Programming in a low-level machine-oriented language (registers, instructions, interrupt management).
- An orientation of an assembly-level programming language.
- Programming in COBOL – a thorough treatment.
- Operating Systems – an introduction of the main principles.
- Orientation about other types of high-level languages such as PL/1, LISP, and TRAC.
- Exercises involved low-level languages as well as the high-level language COBOL. The operating system of the current computer CD 3200 was explained. Programming in COBOL of a larger assignment was carried out in two- to three-person groups under the guidance of assistants.

⁹ A lecture was normally 45 minutes and it was presented to a large auditorium of all students. An exercise hour was 45 minutes given to a group of 15 – 25 students.

B4 Introduction to the theory of information systems and data processing system development work (lectures 20 hours, exercises 10 hours)

This part included lectures on topics

- Introduction to systems work (including the concept of precedence analysis, matrix representation of systems, etc.).
- Information Systems – an Orientation (including the economic quantity of information)
- Performance analysis of computing systems. Simulation.
- Practical aspects of system development work (including the systems life-cycle stages, choice of computer hardware, etc.).
- Exercises included systems algebra and computer system performance analysis.

Literature of the B-level study course

- Langefors B., "Problem, algoritm, datamaskin" (Problem, algorithm, computer), Studentlitteratur, Lund, 1966 (about 25 pages). (B1).
- Langefors, B., "Theoretical Analysis of Information Systems", Studentlitteratur, Lund. (sections 12.1 – 12.11 and 22.1 – 22.2) (B4).
- Gregory R.H. and van Horn R.L., "Automatic Data Processing Systems, Principles and Procedures", Wadsworth, 1965 (pages 1 – 125). (B1, B3, B4).
- T. Ekman and C-E Fröberg, "Lärobok I Algol", Studentlitteratur, Lund, 1964 (B2)
- Bubenko, Jr, J.A., "Databehandlingsteknik", Studentlitteratur, Lund. (about 70 pages) (B4).
- CD 3200 Computer System – Reference Manual (No. 60043800) (B3).
- CD 3200 Computer System COBOL (No. 60132000) (B3).
- An Algol manual for the CD 3200 computer (B2).
- Misc. material produced at the department (stencils).

Examination

Examination included written examinations as well as by "quizzing"¹⁰ of the material presented at lectures and described in the literature studies above. The quiz questions are chosen among a large number of predefined questions distributed in advance to all students. Students could answer a quiz question orally or in writing depending on the nature of the question. If a student had passed all quizzes for a course module, then s/he could be excused for the larger written exam of the whole module.

Appendix B

AB-Level Package

AB1 System theory and control theory (20 hours lectures)

This module was based on books by Langefors (TAIS), Miller & Starr, and McKean. Its main topics were Decision theory, Analysis of Criteria, Systems Theory, and Control of Organisations.

¹⁰My recollection of the quizzing system is extremely positive. Students were orally examined about four times during the course, three at a time. Face-to-face meetings between the examiner and the students made the students to work very hard from the very beginning of the course. Nobody wanted to show bad performance in front of their colleagues.

AB2 Information Systems Theory and Data Processing Techniques (30 hours lectures)
This module was based on books by Langefors (TAIS), and Bubenko. Its main topics were System Algebra, File Maintenance techniques, Performance Analysis of computing systems, Evaluation of Information, and Design of Information Systems.

AB3 Systems Development Work for Administrative Applications (20 hours lectures)
This module was based on books such as "Dansk standardlön", case studies reported by Axelsson & Källhammar, and additional material handed out at lectures. It included a number of lectures regarding methods for systems work and a number of seminars of the different case studies.

AB4 Work on a practical case (18 hours lectures and seminars)

The students (in groups of two) were assigned a systems development task for a fictitious company called KOSAB. Requirements regarding information support in various parts of the company were formulated and given. The task was to develop and design an information system first at an abstract, infological level, and second, to transform this description to a datalogical level design. A seminar was the setting for presentation and discussion.

Literature of the AB-package

- Langefors, B., "Theoretical Analysis of Information Systems", Studentlitteratur, Lund. (AB1, AB2).
- Miller and Starr, Executive Decisions and Operations Research, Prentice Hall, Englewood Cliffs, 1965. (AB1)
- McKean, R.N., Efficiency in Government through Systems Analysis, ORSA No 3, Wiley and Sons, 1964. (AB1)
- Bubenko jr, J.A., "Databehandlingsteknik", Studentlitteratur, Lund. (AB2)
- Dansk Standardlön, published by the Danish Federation of Employers. (AB3)
- Axelsson and Källhammar, five case studies (AB3)

Examination

Modules AB1 and AB2 were examined by "quizzing". Modules AB3 and AB4 were examined by presentation in seminars. The whole AB package was, at the end, examined by a written exam as well as by an oral examination.