The Programming Curriculum
of the ADP Management Training Center

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I'd like to discuss with you a programmer training curriculum in a larger computer-based training effort with two primary objectives:

    1) to provide a broad range of training in vendor-independent ADP topics for interagency government audiences;

    2) to minimize the problems inherent in a situation permitting little control over students (in terms of selection, evaluation, and follow-up).

In an earlier presentation to this group, Professor Lloyd Fosdick stated that the organization providing in-house training employs its students, whereas university students "employ" their school. Not only do the students in courses conducted by The ADP Management Training Center "employ" our staff -- they must be motivated to do so without the university objective of earning a degree or credit toward a degree. The following questions and answers characterize the unique situation we face.

QUESTIONS: What training approach do you take when attempting to teach COBOL, FORTRAN, and BASIC in an environment consisting of:

A. Government employees as students (primarily federal, but some state and local) from many agencies with a broad range of applications.

B. Scheduled classes one to five weeks in length, conducted during working hours.

C. No grading or testing in the traditional sense.

D. A wide variety of students, ranging from GS-1 laborers to GS-18 senior managers, their military and state/local government counterparts, plus occasional foreign students.

E. Diversity of hardware, compilers, and applications at students' installations.

F. A self-supporting (reimbursable) financial basis and consequent inability to enforce strict adherence to recommended prerequisites.

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ANSWERS

A. Make the problem environment a governmental one, i.e., eliminate the classical accounts receivable type of student exercise. The selection of realistic and non-trivial workshop exercises is all important.

B. Forego the use of some of the excellent multi-media packages suitable for in-house learner-paced instruction, but mention their sources (IBM, Deltak, ASI, Edutronics, Honeywell, etc.) to the students. Substitute a qualified instructor, supported by excellent textual material (general) and handouts (specialized), in an environment of good computer support.

C. Make the students feel that the sole criterion for evaluation is their performance on the job.

D. Offer separate courses for upward mobility students, trainee and journeyman programmers, and managers. ("Different strokes for different folks.")

E. Teach, in the cases of COBOL and FORTRAN, only ANSI specifications (and whatever variations are necessary for the system used to support the training). Treat this system as a vehicle only. Emphasize skills in the use of reference materials.

F. Build flexibility into your staff to handle this most troublesome problem of students with widely divergent backgrounds.....also build flexibility into your arsenal of exercises and student programs.

BACKGROUND

Throughout the past decade, the U.S. Civil Service Commission has been actively concerned with the government-wide education and training of Federal employees in automatic data processing and related fields. The initial training programs were started in 1959 with the encouragement of the Interagency Committee on ADP.

On July 1, 1965, THE ADP MANAGEMENT TRAINING CENTER was formally established to fulfill the task assigned to the Civil Service Commission in Bureau of the Budget Circular A-71 -- that of stimulating and coordinating the necessary training for "executives and other key personnel to achieve greater effectiveness in ADP management." The U.S. Civil Service Commission subsequently established regional ADP Management Training Institutes in Chicago, Dallas, New York and San Francisco to more effectively fulfill its assigned task. A still further expansion of ADP training efforts began in FY 72 when the Civil Service Commission started phasing

ADP training into all ten of its regional centers.

The enactment of the Intergovernmental Cooperation Act
of 1968, granting both State and local government em-
ployees eligibility to attend the training courses
offered by the U.S. Civil Service Commission, greatly
magnified the role of the Bureau of Training. Subse-
quent authority permitted the Center to accept requests
from eligible international organizations.

In direct response to a Presidential Order, THE ADP
MANAGEMENT TRAINING CENTER launched its phase of Upward
Mobility Training in the spring of 1971, further diversi-
fying the training opportunities available to government
employees. The eight courses in this curriculum provide
ADP technical training for upgrading the skills of govern-
ment personnel in lower-level jobs. Special training
facilities enhance the practical classroom experiences
of students attending courses in this area.

In fiscal year 1974, THE ADP MANAGEMENT TRAINING CENTER
conducted over 210 course sessions for more than 4,000
government employees ranging from GS-1 through GS-18
(or equivalent).

OBJECTIVES

THE ADP MANAGEMENT TRAINING CENTER offers a curriculum
for continuing education of government employees on an
inter-agency basis. Programs offered by the Center fall
into three major divisions according to participant
needs. All courses are designed to provide the students
with substantive knowledge directly applicable to their
job demands.

ADP USER EDUCATION provides both introductory courses in
ADP for government employees at all levels, and more
specialized seminars which relate data processing con-
cepts to specific subject area disciplines. The courses
present information about the computer, its applications,
and user-management responsibilities.

COMPUTER SPECIALIST TRAINING programs are offered for in-
dividuals who are directly involved in data processing
functions. The courses encompass programming, systems
analysis and design, and other subject areas concerned
with developments in the computer field. Training is
provided at various levels ranging from basic skills for
trainees to topics of a highly technical nature in ad-
vanced techniques for the continuing education of the
computer specialist as a professional.

UPWARD MOBILITY TRAINING provides entry-level ADP skills
in the areas of operator and programmer training. A

specially designed ADP Skills Training Facility has been
built around a representative third generation computer
system dedicated exclusively to hands-on, workshop-oriented
training. The goal is to provide upward mobility oppor-
tunities to those employees in lower level jobs who wish
to enter the career field of automatic data processing.

In addition to conducting regularly scheduled interagency
ADP training in the above program areas, the Center main-
tains additional training and supportive activities.

ON-SITE TRAINING is often conducted to meet the needs of
individual agencies when Center expertise and resources
best satisfy these needs. THE ADP MANAGEMENT TRAINING
CENTER has successfully developed and conducted on-site
single agency courses for the Departments of Health, Edu-
cation, and Welfare; Navy; Defense; State; Internal
Revenue Service; General Services Administration; the
Selective Service, and Law Enforcement Assistance Adminis-
tration. Overseas Interagency courses were also conduct-
ed by the Center under the auspices of the U.S. Army in
Italy and Germany and the American Embassy in England.

STAFF FUNCTIONS include consulting, upon request, with
individual agencies on their ADP training requirements
and providing ADP training support to Civil Service Com-
mission Regional Training Institutes.

METHODS

A wide variety of instructional methods are employed
to achieve training objectives. Workshops, lectures,
panel discussions, group discussions, question-and-
answer sessions, student presentations, tours, practical
exercises, and selected readings are used as appropriate.
In many programs participants are given hands-on computer
or remote terminal experience. Course materials are
provided in all programs to supplement lectures and to
provide participants a source for future reference.

Students in THE ADP MANAGEMENT TRAINING CENTER'S program-
ming courses presently use four types of computer equip-
ment: the Commission's dual large-scale systems; time-
sharing services; analog/hybrid systems (in the SCIENTIFIC
COMPUTING SERIES); and the complete third generation
system operated by the Center. This last computer, pur-
chased with Department of Labor funds for primary use in
upward mobility and manpower development programs, is
dedicated exclusively to training. Several introductory
non-programming courses include demonstrations of computer
equipment and applications.

A great portion of the programming curriculum offered by
the Center consists of hands-on use of these systems in

the realization that the gap between programming theory
and practice is a large one. Languages taught include
COBOL, FORTRAN, BASIC and Assembler, with emphasis on
COBOL and FORTRAN in their approved ANSI and Federal
Information Processing Standard (FIPS) forms.

THE ADP MANAGEMENT TRAINING CENTER is operated as a
completely reimbursable cost center. Accordingly, the
Center's tuition charges are intended to recover the
cost of instruction and materials, development and con-
duct of training programs, and the administration of the
Center. Variations in the price structure of different
courses depend on factors such as the development costs,
the amount of computer time used, the size of the class,
the length of the course, and the nature of the materi-
als used.

STATISTICS

In the fiscal year 1974, THE ADP MANAGEMENT TRAINING
CENTER enrolled 586 students in programming courses for
three audiences: Computer Specialist, Upward Mobility,
and Executive.

The Computer Specialist programming curriculum consists
of the following courses:
     Fundaments of ANS COBOL   (2 weeks)
     COBOL programming Techniques   (1 week)
     Fundamentals of FORTRAN IV   (1 week)
     FORTRAN Programming Techniques   (1 week)
     Introductory Conversational Computing   (BASIC-3 days)
     Fundamentals of ADP for Computer Specialist
       Trainees   (COBOL and FORTRAN- 5 weeks)

Our Upward Mobility offerings, most of which relate to
computer operations, include the following programming
courses:
     Introduction to Computer Programming[*] (COBOL-1 week)
     Workshop in COBOL Programming   (1 week)

     *(Based on our 1974 experience, we will break this
     into two distinct courses for FY 1975:   a three-
     day Fundamentals of Programming Logic Development
     and a one-week Introduction to COBOL Programming.)

We also offer a one-week Executive Workshop in ADP Program-
ming, which involves senior managers in both BASIC and
COBOL programming and testing. The emphasis in this
course is on developing a sense of the context and envir-
onment of the programming function rather than the teach-
ing of detailed technical skills.

The 586 programming students trained by our Center this
past year (565 if we count only once the 21 executives

who studied both BASIC and COBOL), chose languages as follows:

COBOL-389   161-Fundamentals
                             141-Upward Mobility
                              66-Techniques
                              21-Executives
FORTRAN-127   104-Fundamentals
                              23-Techniques

BASIC-70   49-Introductory
                              21-Executives

ADDITIONAL CONSIDERATIONS

The self-supporting nature of THE ADP MANAGEMENT TRAINING CENTER determines to a great extent the characteristics of its curriculum, staff, and course validation and development procedures. The curriculum, presently consisting of 66 different courses, offers only subjects which can be effectively presented in an interagency, scheduled classroom environment. Where a particular topic is readily and economically available in the private sector or through another government source, we rarely attempt to duplicate it. Highly specialized skill areas, in part because they tend to be somewhat vendor-dependent, are rarely included in our calendar of training. The majority of our ADP User Education courses are of the applications-oriented survey type, while Computer Specialist and Upward Mobility training emphasize the broad skills of systems analysis, programming, and operations.

Our approach to staffing is to seek individuals well-qualified as Computer Specialists and either interested or experienced in teaching and course development. We have been successful in keeping staff turnover low because we offer a journeyman grade of GS-13 and considerable freedom with regard to new course selection, training methodology to be used, and resources for support. Attendance at professional meetings, conferences and training courses is encouraged because our instructors rarely have the opportunity to return to the "firing line" of computer systems, except in direct support of our training program.

Validation of the success of our curriculum is predominantly left to students and the agencies sponsoring them. Because there is no mandate that government students enroll in our courses in preference to those available from other sources, we must compete with organizations offering public courses and seminars. The continuing growth of our programs indicates satisfaction within the government community, as do the majority of the parti-

cipant evaluation/critique forms submitted by students.
Our instructors are extremely responsive to the written
comments of students and have changed significant por-
tions of courses because of student recommendations. It
is interesting to note that courses taught by our own
staff generally receive more favorable student reaction
than those taught by either contractors or individual
guest faculty. We feel this response is a result of our
skilled professional staff, the continuity they bring to
a course, practice, and -- at least in part -- the more
easily manageable skill-related subject matter we assign
to our own people.

New course development is a function of perceived needs,
staff ideas, and requests from the community we serve.
When a course is initially developed and conducted by a
consultant, it usually continues to be presented by con-
tract; in some instances, our own staff has taken over a
course after it has been conducted a few times by con-
tractors. Courses originally developed and taught in-
house rarely shift in mode of presentation except when
staff resources become critical because of illness or
travel.

Contrary to the highly structured, centrally documented
military approach to training, courses offered by THE
ADP MANAGEMENT TRAINING CENTER bear a highly personal-
ized stamp of the instructor or instructors doing the
teaching. Although this approach requires some rein-
vention of the wheel, such an exercise, regardless of
documentation quality, is necessary whenever a new in-
structor assumes responsibility for a course. Within
the constraints of required topics, we feel that in-
structors should be given maximum freedom to select
their own lecture and workshop approaches, materials,
and exercises.

INGREDIENTS OF SUCCESSFUL PROGRAMMER TRAINING

There are five elements essential to the conduct of
sound classroom programmer training:

A. Establishment of an informal (egoless?) learning
    environment with free flow of questions and answers.
    This requires occasional discipline on the part of
    the instructor who must respond to poor questions,
    but the advantages clearly outweigh the shortcomings.
    An initial admonition to students that there is no
    such thing as a "dumb question" plus reinforcement
    of this attitude can contribute materially to the
    success of training.

B. Good training and reference materials. Both are
    needed, but both are rarely found from the same

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source. A good general textbook (hardware indepen-
dent where possible) plus carefully designed, speci-
alized visuals and handouts (such as a table of dis-
tinctions between COBOL file and record names) are
essential.

C. Provision of a small pre-written program to students,
complete with specifications, flow chart, coding
sheets, listing, and input-output samples. The class
is led step-by-step through this program _before_ any
discussion of language specifics. Such an exercise
minimizes the importance of presentation sequence for
the language syntax and semantics. This program must
be representative of the most commonly encountered
fundamental language structures and command types,
without being either trivial or unnecessarily com-
plex.

D. Students who have the ability, temperament, and moti-
vation to learn. This is the most difficult ingredi-
ent to guarantee.

E. A qualified instructor, plus qualified workshop
assistants. A qualified instructor must have been
an operational programmer at some time, although not
necessarily in the language to be taught. He or she
must also enjoy teaching. The combination of these
two features, though not the rarity it is sometimes
considered, is sometimes difficult to find. If the
individual likes to teach, he or she will inevitably
become technically qualified in the assigned subject
matter.

UNSOLVED PROBLEMS AND STEPS TAKEN TOWARDS SOLUTION

A. Handling a diversity of student backgrounds and
learning speeds: this difficulty is minimized by
describing course content and recommended prerequi-
site training explicitly in course publicity, and
by building some alternatives into the "bells and
whistles" to be incorporated in student problems.

B. Personality clashes (infrequent but sometime
severe...usually among students rather than involv-
ing instructors): Attempted resolution of this
problem, rarely completely successful, usually re-
quires private conferences between the instructor
and one or more students.

C. Hardware trouble: This necessitates indoctrination
of the vendor, who is inclined to view training as
less important than production. If you approach the
matter by describing the disastrous results of a two-
day schedule slippage in a ten-day course in

relation to the consequences of a similar production slippage, you may generate a minimal amount of sympathy for your plight. Good luck!

D. Bridging the gap between theory and practice: Make the student aware that what may seem completely understandable when presented outside of any context may become quite confusing in relation to an actual programming assignment. This difficulty will never be eliminated, but it can be reduced by the assignment of a pencil and paper problem, unlike either the completed handout program or the workshop problem(s) to be actually run. Such an exercise may be more trivial than either handout or workshop programs, and still alert the student to the general types of contextual difficulties to expect in the later workshop endeavor. THIS INTERMEDIATE STEP IS OF CRITICAL IMPORTANCE!

E. Keypunching (batch) and keyboard (timeshared) turnaround and quality. If your in-house organization cannot provide the needed service, the expense of a contractor who provides overnight turnaround may be justified. In the case of terminal usage, availability of off-line terminals for recording of student programs on paper tape or cassette is recommended. In the timesharing environment it is important that the entry of programs be accomplished by the students.

F. Inability to teach "Preventive Programming Fundamentals", i.e., failure to eliminate the most common student errors, even after warning the class of their frequency. One approach to the reduction of this problem is to hand out a program containing most of the syntax errors normally encountered in first programs, along with the diagnostics generated. This does some good with the area of mechanics, but doesn't help with logic. Structured programming concepts appear to hold real promise in this area.

G. Lack of time to teach the skills of problem analysis and flowcharting in a one or two-week course, because of the repetition and reinforcement necessary to communicate such critical concepts: Recommended prerequisite training, plus optional handouts providing detailed guidance, can help in this area.

CONCLUDING COMMENTS

The training of programmers is an interesting endeavor, and a generally successful one given appropriate attitudes on the part of both students and instructors. By far the most interesting elements of the curriculum

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discussed above are the unique courses at the two ex-
tremes of upward mobility and executive training.
Teaching programming to disadvantaged students is both
challenging and rewarding. The intensity with which
many of them attack the subject matter is remarkable;
their seriousness has even caused some of our instructors
to give these students their home telephone numbers so
that they can get assistance when working on programs in
the evening and on weekends.

Training in computer programming for senior executives
has an objective different from that of upward mobility
training: The latter emphasizes technological skills,
while the course designed for managers seeks only to
communicate the programming environment by placing execu-
tives in it for a concentrated week of BASIC and FORTRAN
learning. An appreciation rather than a detailed com-
prehension is sought as a result of this managerial ex-
posure to the detailed realities of the programming
function.

Whether training upward mobility students, journeyman
computer specialists, or managers in the intricacies of
computer programming, THE ADP MANAGEMENT TRAINING CENTER
effectively combines conventional teaching methodology
with the appropriate support resources to minimize the
problems inherent in a somewhat uncontrolled student
population environment. The result of these efforts is
effective interagency ADP training for government em-
ployees.