APL
PRESS

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APL NEWS

@ t[e// s4aait
The grade-up function, A, is one of the of all APL primitives.
lf f is a numeric vector, {I/ generates
such that ytAyl is in non-decreasing order.

c

SAMPLE STRING (d,ap'sr)td(rpd),s 9 101

SAMPLBE STBRBIN G

most versat i I e

the indices
For examp le,

v

31.5243-2"823

iv 6231547
-

vI" Av1 2.8 1.5 2 3 3 4 23
Notice that if some number occurs more than once in
r, the corresponding indices in A/ are in ascending order:

B

110000

AB 345612
What is surprising is that the grade-'up function may be employed where the need for sorting isnrt readi ly apparent.

Consider the fol lowing problem: one wishes to insert the letter tBr after the fifth, ninth, and tenth elements of some character vector d" one way to do this is as follows:

,lt ls very instructive to study thls example.
ln general, if we wish to insert Btll after the atllth

element of C, Bl2) after the At2lth element of d, and so on, the expression (c,B)td(rpd),.41 does the !rick.
As an example of the usefulness of this insert tech-
nique, consider the following. You wish to print a message

when a workspace is loaded by usinc Urx. Suppose r is the character vector containing the message. Then, slnce tEtx is performed when the workspace is loaded, ALx+tttt,y, I ' rr would

seem to solve the problem. However, if v+twHArtts Nav?t, then "r,,7,rr" results in a tSyN?AX aPlO.B, since a double

quote ls needed.

F
I
I
I

I fnus, we need a function to take a character vector
I r "and make it executable by inserting a quote after every quote

F lYin v (as wel I as at the beginning and end of /). The fol low-I - ing function accompl ishes this.

I r z+Qao?E vi.
J t1l R+(tttt=vr/rpR

I L2) z-(v,(pR)pt , ") ti(tp v),Rl t"' lvI vum's ntvz I AUoIE V

tTEATtts NEnzl
tQUoIE v
WHAT ' S NEI,I?

As another use of grade-up, consider the construct
dlv. This expression, called rrdouble up-graderr, gives the
Iillk of each element in 7. For example,

3 1.5 2 4 3 -2.8 23

idY 4236517

indicating that 3 is the fourth smallest element ln v, 1.5 the second smallest, 2 the third smallest, etc. ln general, ytll is the (iAr)tI(lth smal lest element in I/. For example,

S?A?E S
PA
CA

NI
rx

r 9*n" I eoe

I r1793909 199s3134 18190740 11196730 7168164
I

I AREA ' 45333 158693 267339 7836
i

'. srATqs,<as lpi6POP),rs 1'pit'AREA

PA32
cA 5 4
il?.Y 4 3
' TX25
NJ 7 7

This last expression lists five states with their relative rankings by size and population. Pennsylvania,
for example, is trd smal lest in population and 2nd smal lest
in size.

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Problems orooosed in this issue

1. The grade-down function, Vv, is defined as A-y. what is the meaning of dvl/? compare with Adv"

v

2. Find the

smal I est V+2357

shortest APL expression for the lndex of the
element in a vector I/, For example, if
4, the result should be 4.
5. Write an inverse function to r, that is, write a function

11t7 such that rllvr r is the same as.x for anv arrav x. (Hintr for character vectors, use QUorE), llhat might be

some uses for rvv?
4. lf a is a Boolean vector (consisting ontv of 0rs and 1rs), what is the meaning of <r/B)+!B?
5. Write a function, UNISUE, that takes a numeric vector f as its argument and returns a vector consisting only of the distinct e'lements in v, in ascending order. For
examp I e,

UNIqUE732135 7235
6, Of what use ls the expression n[Afln<.-Qfi-M,0;] ?

Answers to problems oosed in Newsletter l

L. 7b22pt tp' t t7p22p77pt t'with length 22, is still the
shortest known SRt,
2. Toshiko Maksymowicz of White Plains. NY, sent in the following remarkable expression which generates itself after two appl ications of the execute function (but not after one):

v

+7 p29p28pt t t l(27 L77 + 1,721 , | 27 7+1p 29p 2ap t
tv

I E (27 lr7 + | 7 2), | 27), | 27 7 47 p 29 p 28 p t | | t (27 L L7 + \ 72' t 27 1

ztv

47 p 29p 28p t t tt(2'1L77+r12,,r27147p29p2apt
3. Ms. Maksymowicz also sent in an saB of odd length (13): 192o3qp-1017p,,'21+2034p-1017p | | |

.-i

q"\P[in flelea.9aztdertu
9,4o.aloa./af- SOUTH AUSTRATIAN Educaltan
SECONDARY SCH(ELS 9e7aol"na,*f
The development of the APL system currently used in South Austral ian schools was begun in June 1970. The initial

system was a restricted one, designed to be run on an gK IBM 1Ll0 with punched card input and console typewriter output. 0ur current APL is a marked improvement on the initial version.
We now operate an IBM 5701115 with optical lvark Read card in- put and with the output being produced by a line printer with

a ful I APL character set.

APL is not the only language offered to schoois. l,le also support BASIC and SAM (a simulated Student Assembler and

Ue.e,LLnc lansuase). Back in the rr:o aa vil-TFiiEl-!?TllTte t v

the most powerful language available to our schools because of the restricted nature of Li.30 BASIC and it was the most used of the languages offered, With the introduction of 570 VS BASIC, APL is no longer the number one language in terms of numbers of student users, but it is stili widely used and has a flrm following.
APL has been used extensively in the development of packages for use ln our schools. A package is a set of functions (or BASIC programs) designed to simulate physical
phenomena, produce teaching aids, further computer awareness etc., and a set of notes to guide the student/teacher use of the functions. Users need have no programming knowtedge at

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il . Packages are also supported on specially designed 0l4R \ards. APL is an ideal language for this appl ication becaftse of its nodular nature and range of primitive functions. We read all data in as a string of characters, check to see if

each item is in the correct form, convert lt into numeric form lf this is the form required (and the card has been correctly

marked), iheck that the number so formed is within the lirnits

set for that data item and, if so, accept it. lf the input fails any of these checks, a message is printed to indicate to the user what the nature of his error ls:
"You have marked the card incorrectly, a number was
requ i red. "
rrYour input was too large, it must be an integer

between 1 and 10.r1

Folloning this, a reasonable su.bstitute is selected for the data item and the user is inforned of the change.

By doing this, we lncrease the chance of the user obtaining some meaningful out- put. As many of our schools are more

than 1.00 metres frorn the computing centre, we feel that this is essential (some are 400 miles away).

lJhat then, makes our APL different from other APL systems? L. The most obvious thing is the mode of input. We operate within a predominantly batch optical Mark Reader card input. Each card, of punched card size, carries 12 columns printed as shown (enlarged) on the right. Students mark the card with

2B pencils or felt tip pens, characters
are either in "bubbles" or between rrbubblesrr. A rrbubble" is the sDace Aon

the card. The rules for card markin! are simple. lf the character is in the bubble, mark the bubble, if it is between

two bubbles, mark the bubbte below and

above it (for vertical placement) or on either side of it (for horizontal place- ment). The oMR input enables students to

prepare input in the classroon, at hone, even in the school bus (in country areas).

2. We have three supporting texts deslgned for secondary student use - "APL/ANILPK" parts 1, 2 and t. These books contain material related directly to our APL sys-

tem and they are aimed at a student pop-ulation. The texts are offset printed,

foolscap size books with worked examples. (There are no photographs - costs have
been reduced to a minimum.) A range of inservice teachefreducation conferences are avai Iable fr:m their school s for this

purpose. (0ur<--Edircation Department offers a wideaiange of such conferences in all su6-j e-ct areas.) This is not part

of our APL system, but it does aid lts use in the schools.
5. We have developed a few special primi-tives to service our particular needs, including a plotting primitive B, and -a pr inter control 0.
4. The only control card used is a red sign-on card, prepunched and provided with a school sign-on number and name.

Schools are allocated one workspace initially, but may request more (as can

0p

U
A

l1

B

2+

C
n

3x

D

4+
E
n

5t
F

$-+

G
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H
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Al I student jobs have a time t imit of and a limit of some 50 pages of output. card system is essential for general

The use made of APL varies markedly from school to school. We have no formal certified courses in computing in South Austral ian Programming, it is taught as an option within the school curriculum, part of the mathematics course, or as

a club activity. An average of about 100 schools use our fa- cility, some use just APL, some just BASIC, and some use both.

From September 1976 to April. there were 13,L91. sign-ons and 109,568 0i4R cards for APL, and 23,212 sien-ons and 358,315 cards for BASIC. ln the last ten days af the period (the r

middle of the first school term), 1755 student batch ApL jobs

were processed, along with 3097 BASIC and 223L package jobs, i.e. an average of 708 student batch jobs per day.

It should be acknowledged that our APL syStem was de- veloped initially by Mr. J. Clementi (of lBll South Australia)
and Mr. B. James. Mr. James has continued the development of this system as his Ph.D. research and is now our systems pro-grarmer. The student texts (APL/ANcLp,(parts 1, 2 and l) are available from Mr. Clementi, Ayers Hill Road, Stirling, South

Austral ia 5152, The cost, including postase, is $5.00 each.

The fol lowing text, publ ished by McC ,,-Hil I in 1974, is now avai lable from APL Press:
RESISTIVE CIRCUIT THEoRY by Robert Spence
Paperback, 279 pages, 1.95 exercises. Price: g12,00
From the P reface:

\ Another freshman level book on circuit theory? Yes. \ ,ls it sisnificantly different fron all the others? Yes. VTwo depaitures disiinguish the present text: the topics treated are restrlcted to resistive circuits. and the

mathematicat notation used is restricted to a simple
wel I -def ined system, APL.
APL is a simpl ification and extension of the fami I iar notation of vector algebra which extends its domain of

aDpl ication far beyond'l inear algebra, and enhances the role of arrays (vectors, matrices, etc.) as an important tool of

organized thouaht. lt is also a computer language, aod every mathematical expression occurring in the text can be entered without change and executed on an APL terminal.
It has the ability, as a notation, to suggest useful general izations of functions and relations already defined, and thereby extend their range of validity or shed further 'I ight on their underlying structure. lt is exciting to ex-perience this aspect of APL, and one is reminded of Bertrand

Russel I rs saying that rrA good
suggest i veness which at times
I ive teacherrr.

notation has a subtlety and
makes it seem almost like'a

The executabi I ity of APL permits a student at an APL terminal to readily experiment with a wide variety of inter- esting circuits, and thereby gain insight into circuit be- haviour and the structure of circuit theory. Theorems can

be discovered rather than encountered first via statement and proof. Speculative ideas can easily be tested.
Because of its simple syntax and similarity to vector algebra, APL is easy to learni one hour spent exploring the language at an interactive terrninal is sufficient to give the student or teacher a feel for the language and enable him to start using it. The importance of this ease of learning wil I be apparent to any teacher who has examined computer-oriented texts on circuit theory which require the student to use Luq systems of notation (one for the computer and one for the

blackboard) and to learn inessential details of the mechanics of compu te r s.
one significant aspect of the text which derives from
the use of APL is its algorithmic and experimental flavour. At each stage in his understanding of the theory, the student is abie to obtain experlence of the pertinent relationshlps, both by executing the expressions appropriate to specific circuit examples, and by lncorporating the expressions in defined functions which are then av€ilable as building blocks in further analvses' Moreover, the function definitions serve to summarize, in a precise and readable

symbol ic form, important retations which the student has just learned and which he will later wish to use as tools.
When pianning this text I real ized that manv of the
central theorems and concepts of circuit theory might best be introduced and explored within the simpler context of {

purely resistlve circuits, leaving the dynamic behaviour of Y circuits incorporating inductive and capacitive elements to be treated in a subsequent (or companion) course' The inclusion of both nonreciprocal and nonl inear resistive circuits gives the student a broad and realistic experience of ci rcuit theory. lndeed, in subject matter and approach

,the present text resembles the first of two courses (Resistive Circuits, and Dvnamic Circuits) p.roposed bv the

co ei commission on Engineering Education (9/68). CHAPTERS: 1) Circuit Design; 2) Measu.rement and Model I ing of 2-Terminal Components, 3) Component lnterconnectioni 4) Sources and Power; 5) signals; 6) Measurement and Modell ing of 5-Terminal ComFonentsi 7) Topologyi 8) Circuit Descriptioni
9) Linear Circuit Anaiysisi 10) Linear Circuit Propertiesi
11) Nonl inear Circuit Analysisi 12) Smal l-signal Behaviour of Nonl i near Circuits.