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APL NEWS

APL 79

the AgL 79 Conference sponsored by STAPL will be held in Rochester, Rochester' New York' It{ayIaY 30 -Jwne t, 7979. fhe nrosram will feature a number off invited speakers and '

progran will feature a
iccording to the Call for Papers I "will be devoted to all aspe;ts of APL includingi Applications in all axeasi lhe language t lnplenentations t APL in education; Interfaces with other software systensi fnterfaces with sDecial Durpose hardware t APL system organization and nairagement; Relations to lisp and other languages !'. Again quotirrg fron the Ca1l for Papers ' "l'urther infor-

nationhay be obtained fron either the Prograll, Ctlairman (kofessor PauI Penfield' Jr.r Room 38-401' Massachus-

etts Institute of Technology' Canbridge' Massachusetts 02139, relephone 6I?-253-4607) or from the General. Chairrnan, Sletcher tlcTaggart, I.P. Sharp Associates, Suite 1150, 183 Main Street East' Rochester, New York 14604, Ielephone ?76-546-72?0,

CORRECTIONS

kofessor Mauldon has submitted the following correc-tions to his note on Ultinately Periodically SeIf-Reproclucing Erpressions which Lppeared in Newsletter 6r

1. lhe final quote in the last APL expression I should be deleted.
2, If 2<pA the result of [,4 varies slightly
flon systen to systen. Replacing each
occurrence of the slrnbol Y in the functions
sfia and SRE2 by 2 ot relroves this difficulty.
NEIfII AVAIIABI,E FROM APL PRESS
Proceedinss of An APL Users Meeting, Sept'.18-20, 1978.
- (see pages 3 and 4 for details)

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These proceedings of a conference sponsored-by I. P' Sharp-Associites in S6pternber, f978, in Toronto, ilclude several-\- pa?ers in each o-f the f;l"l-owing segsionsr Direction of APL-beirelonments; I'inancial Planning i APL in Exposition; Appli-cationi in the Actuarial and Inaurance Industry; In-house MiErations; Graphics and PLotting Applications in Business and Industrvr loEistic Svstensi Financial Applications in the Resource Inilustril Appli-cations in Banking and Finance I Quantitative Anaiysi-s- and Statistical Techniques e APL Stand-ards for Docurnentation and Prograrnning.

PROMEDINGS OF AN APt USERS MEETINC

RISISEM CIRCUIT TH3oRY R.l' Spence

381 pages

279 paees

This is a freehrnan 1eve1 introduction to circuit theory litrli-
iea-to -
res istive circuits (linear and nonlinear) a1$- 9np1oy- i; nPI-;; lire maitrematical notation. fhe executabilitv of lpE ".rmits a student to experinent with a wide variety of

circiits, and thereby gain insight into circuit behavior and in. -siru6tures of cliciit theory. Circuit topology is des-"ribed bv the node-bransh incidence matrixi the use of APL

makee oo6sible sinnle explicit expressions for conductance ;ilt-iri;a;;; matrices, ind for Kirchhoffrs laws' CHAPTERS r Cireuii Design; Measurenent and Modei-Iing of 2-Tenninal com-oonents: Cornponent Interconnection i Sources and Power; 5i.n"fsi Mea'surement and Modelling of'3-Ierminal Components i T;;i;;", circui.t Descriptiont linear Cireuit Analaysis i liirear"'Circuit Propertiei t Nonlinear Circuit Analysis ; Sma1l Signal Behavior of- Nonlinear Circuits.

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APt AND INSICI{T

STARI/IAP !.C. Berry and J.c. [horstensen 41 pages

P. Berrv, G, Bartoli 8P Pages
C. Dell-'Aquila' v. Spadavecchia
This book discusses the use of Alf, and APL prograns to rep-reJlni coneepts in teaching. It includes examples drawn fr'- eieroentary pirysics and conputer science, and. discusses th9 f-Drograruning style approPriate to use 1n teaehlng. 'lne naln

iir"fieJ are-tnai tne- ley- concepts of serious disciplines qan t. rerresentea as funciions, tirat gtL permits a readable i""i,f- i"i-i"ition of a function and a means of executing it' anA tirat it is possible to write programs.so that-they cor-t"Jpo"a directly to the functional concepts of a disci'pline'

This book provides a conplete and concise statement ' in APL r"".ti""".-"r a sinple n-od"I of the solar system (ignoring
"ii"ri"i"' i"t"ract i-ons) . she functions are written so as to

fi;[;-;i;""t ihi structure of the underlying nodel by providing

formal definitions for a vocabulary of terms and cone-epts

-

Smiii"" in astronorny. Stav tables are included so that the nfil-i"""ti-"h' iogetirer wi'th standard plotting functions, permit a user at an APL terrninal to produce a nap of tt-Ie sk{ 5.- ii -"no"ia-

upr:ear auove any place -on Earth, at any tirne of
diy or night, -over a considerable range of dates'

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MATHEMATICS

A coherent three-volume sequence in the central toplcs 5-.elenentary_ rnathematicsr bridging_ the years from hlgh

sEhool through first year colJ-ege' ls provided byr
AIGEBRA r an algorithrnic treatnent
EI,EMENTARY ANAIYSIS

CAICUIUS in a new key

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E. Iverson 218 pp
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D1-2O53
Co,xD

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D.

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APL is used as the exclusive mathematical notation

throughout -- in erposition, in proofs, and in exercisee, [his notation is very close to conventional algebra but ls

simpJ-er and nore general- ' and is directly executable on an

APL conputer exactly as wrj-tten. Although an APL conputer is in no way essentlalr it is a useful adjunctr renoving the

tediun from some of the exercises and encouraging an elperi-rnental approach to the erploration of mathenatical toplcs. The simplicity and precision of the notatlon makes
possible an algorithmic treatment -- every functj-on lntro-

duced is defined in terms of at least one explicit construc- tion. Even if a computer is not available ' the algorithmic

treatment presents the essentiale of cornputer programming in a nathenatical light' i.e., as the precise definition and application of functions,
The simplicity and precislon of the notation have also
rnade it possibl-e to place a greater burden than normal 8n the exercises, This is reflected in their number and variety' and in the fact that interesting and non-trj-vial results are developed in them. [he extensive exercises nale it possibJ-e to foster a great deal of independent work on the part of

the stuitents. Finallyr the exercises can be used effectively in courses devoted to teaching the API, language itself.
Because the notation aDplies to vectors and rnatrices

,- lists and tables, as they- ire called in the algebra text) Nfa-Efipre anc unif-6rrn marm6r, tables are used ex{ensively

to give a graphic view of functions
by displaying the patterns produced
by applying them to vectors. [hey
are also used to clarify topics which
use vectors directly' such as linear
functions and polynomials. For ex-

ample, the presentation of a scheme for determining the product of poly-

nornial-s is shown at the right, 6

The notation provides simple explicit rneans for func- tion definition, and the notion of functionjs emphasi-zed in

al-l three texts, The El-enentary Analysis and Calculus tet*s employ a particularly sirnple and effective form (that covers recursive definition) which is discussed in the first i-ssue of APL News, available on request,

A 42-page solutions book for the algebra text is availabte; otherE are in preparation.

INTRODUCTIONS TO APt

Three introductory booklets by K.E. Iverson previously published by IBM Corp. are nov. available from APL Pressr -.'-

2s poges

In introducing the use of a conputer to teachers it is desirable to start as soon as possible with rnateri-al which

they can see is relevant to their topic and their students ' and to avoid digressions concerning the conputer and conputer

language. fhis book presents such an introduction to API for teaaheis of high school nathematics. Much of this naterial should also be suitable for teachers of othe" topics at other levelsr although they would also benefit fron auxiLiary naterial specifieally addressed. to the topic of interest. CONTENTS r Introduction r Experinentation ; Systernatic 34reri-nentationr Multiplication and other Function Tablesi Graphs

and 3ar Chartst Indexing and Characters; Exploring Functions of One Argument t Defining New Functionst Inverse I'unctions t

Surmation and other Functions over a list; Factoringi linear Sxpressionsi l,inear Equations; Tables and Graphs of linear Functionsi Pollmomials i Generalizing a Function by Use of ?atterns i lhe Positive Integers i Sumnation of Seriesi Power Series; Differencing a I'unqtioni CombinEtions and Sinomial Coefficients; Iteration; References to other Topicsr References t Surnmary of Notation.

INTRODUCING API TO IEACHERS

AN INTRODUCTION TO API FOR SCIENTISTS AND ENGINEERS

API. IN EXPOSITION

This is an introduction to API addressed to the
scientist or engineer and designed to exploit any previous acquaintance with the very sirnilar notation of vector algebra, A careful study of these pages should bring the reader to the point where he can begin to make serious use of API, in some topic of interest to hin. The use of an APL ter-

minal in this study, while not absolutely essential, adds greatly to the depth and j-nterest of the work. \/
The pleasure and efficiency of learning by experinent-ation is not sufficiently appreciated, and the first six pages are clesigned to encourage this t''pe of use of a leiminal in learning APL. fwo pages are devoted a variety of identities and proofs expressed in APL,

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6l pogc3

This book illustrates the use of APt for exposition in tlle teaching of various topics. The first section presents

the characteristics of the language, and each of the other sections illustrates its use in sorne discipline' The topics treated arer Elementary Algebra; Coordinate Geonetry and Staticsi !'inite Differences and the Calculus i Logici Sets; Eleetric Circuits; The Conputer.
AEL VADE MECUMT A complete sunnary of APLSV on a waLlet-eized plastic cald.

STItt MORE

ON GRADE .tlhzmam A.Thbmean

The aim of this note is to describe the relationship the grade functions I and V and the symmetries of the
As remarked by McPherson in APL News 6, a permutation
P can be converted to and from a permutation matrix ?11

MAT:(tpP)..=P PERMT+l+\sM

between
squa re .

vector
by:

correspond-
the i r effec t

the square,
words W made

A squa re possesses is invariant under

0 at the center of its sides, we can

8 symmetries in the sense that its shape 8 plane transformations. Taking an origin the square, and axes 0x, Oy paral lel to denote these 8 transformations as fol iows;

I
R
H
s
X

P

a

: ldent i ty
: Anti-clockwise rotation of g0 degrees about O : Ha I f-tu rn about 0
: Clockwise rotation of g0 degrees about O
: Refl ect ion in 0x
: Ref lect ion in 0y
: Reflection in diagonal axis x = y
: Reflection in diagonal axis x = -y

Suppose now that W is a word from the atphabet which consists of the two symbois A and f. lt is reasonable to ask what transformation of M corresponds to the appl ication to p of the function represented by the word W. .John Mcpherson pointed out in APL News 6 that the words VT{ and Vg and V

correspond to the transformations R, H, and S respectively.
-The picture can be compieted as fol lows: t
\; r: emptyword

x : If Y: Vt P : Att or VVd Q;A

lf, as we must now suspect, there is a one-to-one
ence between distinct wbrds W (i.e., distinct in

on a permutation vector P) and the symmetries of then we conclude that there are iust 8 distinct
up from the function symbols I and V.'

the group of plane transformations l,H,X,y,R,S,p,Q is an instance of what mathematicians cal I DL -- the dihedral group of order 4, that is, a group whose elefrents can be defined in terms of just 2 elements, one of order 4 and the other of order 2. (An element A is of order N if N is the smal lest integer for which A'rN = identity. Note that A represents a

function, thereby demonstrating the desirability of a power operator in APL !)

For example, the group of plane transformations can be deflned in terms of. say. R and X, since R*4 and X*2 both.s,--\. Moreover, il:r:::, ::d^l:':fr^l=.11: we 1"111, l:Il:,I=ITI_l:1 9:tRRR\r can choose which two elements generate the group elements elements orovided provided one is of order 2 (but not H).), and the other is of order 4. ln particular, if we choose S and

and Q as the generating elements, we have an exact correspondence (technically an isomorphism) between the

elements S and Q deflnlng plane transformations, and the functlons A and V which define the essentially different

words which transform any glven permutation vector.

0f course internal symmetry in the permutations themselves wi l1 sometimes bring it about that these 8 words will not all generate different permutation vectors from a given original. For example, the permutation rpP has only two

different forms, 1pP and 01pP. lt is also clear that no permutation can belong to more than one such set of I or less, and so the effect of applying the 8 different words

to aLL permutations of 1pP is to partitlon the lpP permut-ations into sets of 2, sets of 4, and sets of 8. The table below gives the number of such sets for different values of pP.

123456 65t+32L f24356 65t42L
153\26 624351 L5\326 6234sL
321,654 t+56L23 35L62t+ 426L53

oP Sets of-2 Sets of lr Sets of 8 Totals

6
24
120
720

253L4

L45236
214365

1

I
70

1
2
10
35

1
4
4
L0

3
4
5
5

The interested reader should sketch the permutation matrices corresponding to one element (permutation) of

each of the various sets.

For P<-r4, the perniutations are partitioned as fol lows:

L234 432L
L124 4211.

2143 3\L2 tL\2 2413
2L3\ 342L L243 \3L2

32L4 23\l L\32 \L23 ztr\ 243L L425 42L3 t24t 4L32 13\2 3L2t+
For P<-r5 and P=l6, the sets of 2 arei

L2385 5t+327 L4325 52t4L 2L35\ 45t12 \1352

L32546 64523L
213465 5643L2

63254L
5634L2

I
I
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