

BELL TELEPHONE LABORATORIES
INCORPORATED

THE INFORMATION CONTAINED HEREIN IS FOR
THE USE OF EMPLOYEES OF BELL TELEPHONE
LABORATORIES, INCORPORATED, AND IS NOT
FOR PUBLICATION.

COVER SHEET FOR TECHNICAL MEMORANDUM

TITLE Runoff

MM 69-1371-12

CASE CHARGED- 39199

DATE September 17, 1969

FILING CASES- 39199-11

AUTHOR M. D. McIlroy
Ext. 6050

FILING SUBJECTS- Computer Aided Publication
Text Editing

ABSTRACT

Runoff is another publication formatting program for GECOS. This memorandum contains a short (3 page) manual for Runoff and an extended example of its use. The main virtue of Runoff is accessibility; the program is not bound to a single peculiar file format, editing system or input-output device.

Text - 3 pages
Appendix 1, 2, 3

BELL TELEPHONE LABORATORIES
INCORPORATED

SUBJECT: Runoff - Case 39199-11

DATE: September 17, 1969

FROM: M. D. McIlroy
MM-69-1371-12

MEMORANDUM FOR FILE

Purpose: Runoff is a simple publications formatting routine. This manual is an example of its work.

Input: Text to be printed and instructions for printing occur intermixed on separate lines. Instruction lines, called requests, begin with a control character (usually ".").

Output: Output lines may be filled as nearly as possible with words without regard to input lineation, or may be copied one-for-one from input text. Right margin justification may be performed on filled lines. Breaks between output lines are forced by certain requests and by input text lines beginning with blanks. Indentation, centering, line length, line spacing, page length, titling and page numbering are controllable.

Titles: Running titles appear at top and bottom of every page, separated from the body by one blank line. Head and foot titles for even- and odd-numbered pages are all independently settable by patterns of the form:

'part1'part2'part3'

Part1 is left justified, part2 centered, and part3 right justified with respect to the margins current when the title was set. Any % sign in a title is replaced by the current page number. Any nonblank may serve as a quote.

Usage: The GECOS job below runs the program. Input is on file IN; output is normally on the printer.

```
$      IDENT   etc
$      SELECT  MCILROY/RUNOFF
$      DATA   IN
input consisting of text and requests
$      ENDJOB
```

Other usage may be declared by a single free field control card on file I* giving options from the following set:

```
RTSS read input file IN in GE-TSS format
WTSS write output file OT in GE-TSS format
```

Requests: In all requests missing n fields are taken to be 1, missing s fields to be "****". Signs + or - may be attached to numeric quantities showed as +n. Signed quantities are increments to, unsigned quantities are replacements for, current values. For examples, see Appendix 3.

request break default meaning

<u>request</u>	<u>break</u>	<u>default</u>	<u>meaning</u>
.ad	yes	yes	adjust (justify) right margin of filled lines
.ar	no	yes	arabic page numbers
.bm +n	no	n=4	bottom margin is n lines below foot
.bp	yes		begin page
.br	yes		break, begin new output line
.cc c	no	c=.	control character becomes c
.ce n	yes		center next n lines, break on each
.cn	no	yes	case normal on input
.cr	no	no	case reversed, exchange upper and lower case <u>letters only</u> on input
.ds	yes	no	double space
.ef s	no	s="****"	even page foot
.eh s'	no	s="****"	even page head
.eo +n	yes	n=0	even page offset is n (see .po)
.fi	yes	yes	fill output lines
.fo s	no	s="****"	even and odd page foot
.he s	no	s="****"	even and odd page head
.in +n	no	n=0	indent margin n spaces
.li n	no		literal, treat next n lines as text
.ll +n	no	n=60	line length including indent is n
.na	yes	no	no right margin adjustment
.ne n	no		need n lines, 2n if double spaced, begin new page if not enough remain
.nf	yes	no	nofill, break on each input text line
.of s	no	s="****"	odd page foot
.oh s	no	s="****"	odd page head
.oo +n	yes	n=0	odd page offset is n (see .po)
.op	yes		begin an odd page
.pa +n	yes		begin page n
.pl +n	no	n=66	paper length is n including margins
.po n	yes	n=0	even and odd page offsets are n, i.e. move all output n spaces right
.ro	no	no	roman page numbers
.sc c	no	c=#	shift character (see below) becomes c
.sk +n	no		skip at next new page to page n
.sp n	yes		space n lines, n+1 if double spaced
.ss	yes	yes	single space
.ta	no	all	tabs set by next line (see below)
.ti +n	yes		temporary indent, for one line only
.tm +n	no	n=4	top margin is n lines above head
.tr cd	no		translate character c into d on output, .tr cdcd... handles many c's
.ul n	no		underline next n input text lines
.un n	yes		unindent, same as .ti -n

- Tabs:** Tabs in input are replaced by blanks. A tab is set in each column occupied by a nonblank character in a special input line following the request. Initially tabs are set in every column.
- TTY37:** Prepare input in normal GE-TSS ascii format and use Runoff with the RTSS option described on page 1.
- TTY33/35:** Prepare (by means of SAV6, CAPDIN or otherwise) a card image file according to keypunch conventions.
- Keypunch:** Card columns 73-80 are ignored. Each character is read as lower case ascii, unless immediately preceded by a shift character (usually #). If the last nonblank on a card is a shift, then the next card is taken to be a continuation appearing in place of the shift. The table below lists all meaningful characters and their punched representations.

Card code	0	1	2	3	4	5	6	7	8	9	[#	@	:	>	?
Lower case	0	1	2	3	4	5	6	7	8	9	[#	@	:	>	?
Upper case	0	1	2	3	4	5	6	7	8	9	[#	@	:	>	?
Card code	sp	A	B	C	D	E	F	G	H	I	&	.]	(<	\
Lower case	sp	a	b	c	d	e	f	g	h	i	&	.]	(<	\
Upper case	ht	A	B	C	D	E	F	G	H	I	&	.]	{	<	~
Card code	↑	J	K	L	M	N	O	P	Q	R	-	\$	*)	:	!
Lower case	↑	j	k	l	m	n	o	p	q	r	-	\$	*)	:	!
Upper case	ff	J	K	L	M	N	O	P	Q	R	hs	\$	^	}	:	!
Card code	+	/	S	T	U	V	W	X	Y	Z	←	,	%	=	"	!
Lower case	+	/	s	t	u	v	w	x	y	z	-	,	%	=	"	!
Upper case	nl	/	S	T	U	V	W	X	Y	Z	-	,	%	=	"	!

bs = backspace
 ff = formfeed
 ht = horizontal tab
 nl = newline
 sp = space



MH-1371-MDM

M. D. McILROY

Attached
 Appendix 1, 2, 3

Acknowledgements, etc.

Runoff derives from a program with the same name by J. E. Saltzer[1]. Other ideas in it spring from observations by B. W. Kernighan, K. L. Thompson and J. N. Sturman. It owes some debt to [4] and [6], which also descend from [1].

The program was written in BCPL[2,3], which was upgraded by D. M. Ritchie to cope with Runoff's special typographic needs. The auxiliary program for use with the 360, which is described in Appendix 2, was written by J. N. Sturman.

Runoff is similar to other programs -- GE Runoff[4], Mace[5] and Pubedit[6] -- available under GECOS. Unlike them, however, it accepts input from cards and ordinary Teletypes as well as from Model 37 Teletypes, and it is not bound to a peculiar file format. It provides more output media options than GE Runoff or Pubedit, and is known to be more reliable than either.

Runoff's facilities for running titles, page numbering, widow suppression and figure insertion are superior to all but Pubedit's. Pubedit has the unique advantage of supporting layout macros; GE Runoff handles footnotes; Mace has font control and proportional spacing with the ultimate intent of driving typesetting equipment as well as computer output devices.

- [1] P. A. Crisman, The Compatible Time-Sharing System, M. I. T. Press (1965), section AH.9.01
- [2] M. Richards, BCPL: a tool for compiler writing and system programming, AFIPS Conference Proceedings 34 (1969), pp 557-566
- [3] R. H. Canaday and D. M. Ritchie, Bell Laboratories BCPL, MM-69-1371-7
- [4] GE-625/635 GECOS-III Time-Sharing Text Editor, General Electric Documentation Standards and Publications CPB 1515A, Phoenix (1968)
- [5] J. E. Miller, J. Kohut, C. C. Lochbaum and M. V. Mathews, Machine Aided Composition and Editing, Bell Telephone Laboratories, Murray Hill (1969)
- [6] R. J. Elliot and A. Kaiman, Computer aided publications editor, MM 69-1373-8

Use of 360 for Printing

There is a program to put output from Runoff on a tape for high quality printing on the Murray Hill 360/30. The program can be used this way:

```

$      IDENT   etc
$      SELECT  MCILROY/RUNOFF
$      DATA   IN
input consisting of text and formatting requests
$      SELECT  MCILROY/RUN360
$      TAPE9   OT,logical.unitD,,tape.number
$      ENDJOB

```

Submit the resulting tape for printing on the 360 with a DOS job deck like the one below. Specify that printing is to be done with the text train. For publication quality results ask also for a mylar ribbon.

```

// JOB job.number name.and.extension
* INPUT TAPE IS tape.number
* 1 PART REGULAR UNLINED PAPER
// PAUSE MOUNT INPUT TAPE ON 180
// EXEC M0335D
/£
// PAUSE

```

The character ~ does not print on the text train.

Examples of Runoff in Use

The source from which the top of this page was prepared appears below, as it would have been entered at a Model 37 Teletype. Some coding techniques deserve mention:

- To make editing easy, it is good practice to begin every sentence on a new line.
- `.in` does not cause a break. To begin an indented paragraph, use `.sp` then `.in`; the reverse may affect the previous paragraph.
- `.tr @` makes @ an "unpaddable" blank.

On succeeding pages appears the source from which the manual proper was prepared, as it was entered on cards. Almost every feature of Runoff is illustrated there. Don't be alarmed by its ugly appearance; the stuff is not hard to type, and it need never be read.

```
.bp
.ll 66
.oh "Appendix 3""Runoff Manual"
.eh "Runoff Manual""Appendix 3"
.of "September 1969""A-%"
.ef "A-%""September 1969"
.ll 61
.ce
Examples of Runoff in Use
.sp 2
.in 5
The source from which the top of this page was
prepared appears below, as it would have been entered at a
Model 37 Teletype.
Some coding techniques deserve mention:
.br
.tr @
-@To make editing easy, it is good practice
to begin every sentence on a new line.
.br
.in +5
-@.in does not cause a break.
To begin an indented paragraph, use .sp then .in;
the reverse may affect the previous paragraph.
.br
.tr @@
-$.tr @ makes @ an "unpaddable" blank.
.sp
.in -5
On succeeding pages appears the source from which the manual
proper was prepared, as it was entered on cards.
Almost every feature of Runoff is illustrated there.
Don't be alarmed by its ugly appearance; the stuff is not
hard to type, and it need never be read.
```

```

.PO 10
.TA (COLUMN 49)

.NF
#RUNOFF - #CASE 39199-11# #SEPTEMBER 17, 1969
.SP
# #M. #D. #MC#ILROY
# #M#M-69-1371-12
.CR
.UL
.CE
MEMORANDUM FOR FILE
.CN
.SP 2
.FI
.EF "%"#SEPTEMBER 1969"
.OF "#SEPTEMBER 1969""%
.OH ""#RUNOFF #MANUAL"
.EH "#RUNOFF #MANUAL""
.TR @
.IN10
.UN 10
#PURPOSE:@#@RUNOFF IS A SIMPLE PUBLICATIONS FORMATTING ROUTINE.
#THIS MANUAL IS AN EXAMPLE OF ITS WORK.
.SP
.UN 10
#INPUT:@#@#TEXT TO BE PRINTED AND INSTRUCTIONS FOR PRINTING
OCCUR INTERMIXED ON SEPARATE LINES.
#INSTRUCTION LINES, CALLED REQUESTS#-#-#-#-#-#-#, BEGIN
WITH A
.UL
CONTROL CHARACTER
(USUALLY ".").
.SP
.UN10
#OUTPUT:@#@#OUTPUT LINES MAY BE FILLED#-#-#-#-#-#-#
AS NEARLY AS POSSIBLE WITH WORDS WITHOUT REGARD TO
INPUT LINEATION, OR MAY BE COPIED ONE-FOR-ONE
FROM INPUT TEXT.
#RIGHT MARGIN JUSTIFICATION MAY BE PERFORMED ON FILLED LINES.
#BREAKS#-#-#-#-#-#-# BETWEEN OUTPUT LINES ARE FORCED BY
CERTAIN REQUESTS AND BY INPUT TEXT LINES BEGINNING WITH BLANKS.
#INDENTATION, CENTERING, LINE LENGTH, LINE SPACING, PAGE
LENGTH, TITLING AND PAGE NUMBERING ARE CONTROLLABLE.
.SP
.UN 10
#TITLES:@#@#RUNNING TITLES APPEAR
AT TOP AND BOTTOM OF EVERY PAGE,
SEPARATED FROM THE BODY BY ONE BLANK LINE.
#HEAD AND FOOT TITLES FOR EVEN- AND ODD-NUMBERED PAGES ARE ALL
INDEPENDENTLY SETTABLE BY PATTERNS OF THE FORM:
.SP
.CE
.IN 0

```

X


```

`PART1`PART2`PART3`
.IN10
.SP
#PART1 IS LEFT JUSTIFIED, PART2 CENTERED, AND PART3 RIGHT
JUSTIFIED WITH RESPECT TO THE MARGINS CURRENT WHEN THE
TITLE WAS SET.
#ANY % SIGN IN A TITLE IS REPLACED BY THE CURRENT PAGE NUMBER.
#ANY NONBLANK MAY SERVE AS A QUOTE.
.SP
.UN 10
#USAGE:@@@#THE #G#E#C#O#S JOB BELOW RUNS THE PROGRAM.
#INPUT IS ON FILE #I#N; OUTPUT IS NORMALLY ON THE PRINTER.
.SP
.NF
.IN +5
.CR
$      IDENT      #E#T#C
$      SELECT    MCILROY/RUNOFF
$      DATA     IN
.CN
INPUT CONSISTING OF TEXT AND REQUESTS
$      #E#N#D#J#O#B
.SP
.IN -5
.FI
#OTHER USAGE MAY BE DECLARED BY A SINGLE FREE FIELD CONTROL CARD
ON FILE #I* GIVING OPTIONS FROM THE FOLLOWING SET:
.SP
.IN15
.NF
#P#T#S#S READ INPUT FILE #I#N IN #G#E-#T#S#S FORMAT
#W#T#S#S WRITE OUTPUT FILE #O#T IN #G#E-#T#S#S FORMAT
.FI
.BP
.IN 0
.OH `#FORMATTING #REQUESTS` `#RUNOFF #MANUAL`
.EH `#RUNOFF #MANUAL` `#FORMATTING #REQUESTS`
.IN 10
.UN10
#REQUESTS:@#IN ALL REQUESTS MISSING N FIELDS ARE TAKEN TO BE 1,
MISSING S FIELDS TO BE `''''`.
#SIGNS + OR - MAY BE ATTACHED TO NUMERIC QUANTITIES SHOWED AS +N.
#SIGNED QUANTITIES ARE INCREMENTS TO,
UNSIGNED QUANTITIES ARE REPLACEMENTS FOR,
CURRENT VALUES.
#FOR EXAMPLES, SEE #APPENDIX 3.
.SP
.IN0
.UL
REQUEST BREAK DEFAULT MEANING
.SP
.NA
.IN22
.TA

```

```

      X      X      X
.UN22
.LI
.AD# YES# YES# ADJUST (JUSTIFY) RIGHT MARGIN OF FILLED LINES
.UN22
.LI
.AR# NO# YES# ARABIC PAGE NUMBERS
.UN22
.LI
.BM +N# NO# N=4# BOTTOM MARGIN IS N LINES BELOW FOOT
.UN22
.LI
.BP# YES# # BEGIN PAGE
.UN22
.LI
.BR# YES# # BREAK, BEGIN NEW OUTPUT LINE
.UN 22
.LI
.CC C# NO# C=.# CONTROL CHARACTER BECOMES C
.UN22
.LI
.CE N# YES# # CENTER NEXT N LINES, BREAK ON EACH
.UN 22
.LI
.CN# NO# YES# CASE NORMAL ON INPUT
.UN 22
.LI
.CR# NO# NO# CASE REVERSED, EXCHANGE UPPER AND LOWER CASE
.UL 2
LETTERS
ONLY
ON INPUT
.UN22
.LI
.DS# YES# NO# DOUBLE SPACE
.UN22
.LI
.EF S# NO# S="""# EVEN PAGE FOOT
.UN22
.LI
.EH S# NO# S="""# EVEN PAGE HEAD
.UN22
.LI
.EO +N# YES# N=0# EVEN PAGE OFFSET IS N (SEE .PO)
.UN 22
.LI
.FI# YES# YES# FILL OUTPUT LINES
.UN22
.LI
.FO S# NO# S="""# EVEN AND ODD PAGE FOOT
.UN22
.LI
.HE S# NO# S="""# EVEN AND ODD PAGE HEAD
.UN22

```

```

.LI
.IN +N# NO# N=0# INDENT MARGIN N SPACES
.UN22
.LI
.LI N# NO# # LITERAL, TREAT NEXT N LINES AS TEXT
.UN22
.LI
.LL +N# NO# N=60# LINE LENGTH INCLUDING INDENT IS N
.UN22
.LI
.NA# YES# NO# NO RIGHT MARGIN ADJUSTMENT
.UN22
.LI
.NE N# NO# # NEED N LINES, 2N IF DOUBLE SPACED,
BEGIN NEW PAGE IF NOT ENOUGH REMAIN
.UN22
.LI
.NF# YES# NO# NOFILL, BREAK ON EACH INPUT TEXT LINE
.UN22
.LI
.OF S# NO# S="*" # ODD PAGE FOOT
.UN22
.LI
.OH S# NO# S="*" # ODD PAGE HEAD
.UN22
.LI
.OO +N# YES# N=0# ODD PAGE OFFSET IS N (SEE .PO)
.UN 22
.LI
.OP# YES# # BEGIN AN ODD PAGE
.UN22
.LI
.PA +N# YES# # BEGIN PAGE N
.UN22
.LI
.PL +N# NO# N=66# PAPER LENGTH IS N INCLUDING MARGINS
.UN22
.LI
.PO N# YES# N=0# EVEN AND ODD PAGE OFFSETS ARE N,
I.E. MOVE ALL OUTPUT N SPACES RIGHT
.UN 22
.LI
.RO# NO# NO# ROMAN PAGE NUMBERS
.UN22
.LI
.SC C# NO# C=### SHIFT CHARACTER (SEE BELOW) BECOMES C
.UN22
.LI
.SK +N# NO# # SKIP AT NEXT NEW PAGE TO PAGE N
.UN22
.LI
.SP N# YES# # SPACE N LINES, N+1 IF DOUBLE SPACED
.UN22
.LI

```



```

.SS# YES# YES# SINGLE SPACE
.UN22
.LI
.TA# NO# ALL# TABS SET BY NEXT LINE (SEE BELOW)
.UN 22
.LI
.TI +N# YES# # TEMPORARY INDENT, FOR ONE LINE ONLY
.UN22
.LI
.TM +N# NO# N=4# TOP MARGIN IS N LINES ABOVE HEAD
.UN 22
.LI
.TR CD# NO# # TRANSLATE CHARACTER C INTO D ON OUTPUT,
.LI
.TR CDCD... HANDLES MANY C'S
.UN 22
.LI
.UL N# NO# # UNDERLINE NEXT N INPUT TEXT LINES
.UN22
.LI
.UN N# YES# # UNINDENT, SAME AS .TI -N
.BP
.IN 0
.OH '#INPUT #CONVENTIONS'#RUNOFF #MANUAL'
.EH '#RUNOFF #MANUAL'#INPUT #CONVENTIONS'
.IN 10
.UN 10
.AD
#TABS:#####TABS IN INPUT ARE REPLACED BY BLANKS.
#A TAB IS SET IN EACH COLUMN OCCUPIED BY A NONBLANK CHARACTER
IN A SPECIAL INPUT LINE FOLLOWING THE REQUEST.
#INITIALLY TABS ARE SET IN EVERY COLUMN.
.SP
.UN10
.UN10
#T#T#Y37:#####PREPARE INPUT IN NORMAL #G#E-#T#S#S ASCII
FORMAT AND USE #RUNOFF WITH THE #P#T#S#S
OPTION DESCRIBED ON PAGE 1.
.SP
.UN10
#T#T#Y33/35:#####PREPARE (BY MEANS OF
.CR
SAV6, CARDIN
.CN
OR OTHERWISE) A CARD IMAGE FILE ACCORDING TO KEYPUNCH
CONVENTIONS.
.SP
.UN10
#KEYPUNCH:#####CARD COLUMNS 73-80 ARE IGNORED.
#EACH CHARACTER IS READ AS LOWER CASE ASCII,
UNLESS IMMEDIATELY PRECEDED
BY A SHIFT##### CHARACTER#####
(USUALLY ##).
#IF THE LAST NONBLANK ON A CARD IS A SHIFT, THEN THE NEXT CARD IS

```

TAKEN TO BE A CONTINUATION APPEARING IN PLACE OF THE SHIFT.
 #THE TABLE BELOW LISTS ALL MEANINGFUL CHARACTERS AND
 THEIR PUNCHED REPRESENTATIONS.

```
.SP
.IN0
.TR @a$
#CARD CODE$$
0 1 2 3 4 5 6 7 8 9 [ ## @ : > ?
.BR
#LOWER CASE$
0 1 2 3 4 5 6 7 8 9 [ -## @ : > ?
.BR
#UPPER CASE$
#0 #1 #2 #3 #4 #5 #6 #7 #8 #9 #[ ## #a #: #> #?
.SP
.TR $$@
#CARD CODE@@
SP #A #B #C #D #E #F #G #H #I & . ] ( < \
.BR
#LOWER CASE@
SP A B C D E F G H I & . ] ( < \
.BR
#UPPER CASE@
HT #A #B #C #D #E #F #G #H #I #& #. #] #( #< #\
.SP
#CARD CODE@@@
@ #J #K #L #M #N #O #P #Q #R - $ * ) ;
.BR
#LOWER CASE@
| J K L M N O P Q R - $ * ) ; '
.BR
#UPPER CASE@
FF #J #K #L #M #N #O #P #Q #R BS #S ## #) #; #'
.SP
#CARD CODE@@@
+ / #S #T #U #V #W #X #Y #Z , % = " !
.BR
#LOWER CASE@
+ / S T U V W X Y Z _ , % = " !
.BR
#UPPER CASE@
NL #/ #S #T #U #V #W #X #Y #Z #_ #, #% #= #" #!
```

.SP
 .NF
 BS = BACKSPACE
 FF = FORMFEED
 HT = HORIZONTAL TAB
 NL = NEWLINE
 SP = SPACE