

TITLE: Roots of N^{th} Degree Polynomials, where $3 \leq N \leq 10$

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DATE: 9 December 1959

ABSTRACT:

DISCLAIMER:

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TITLE: Roots of N^{th} Degree Polynomials, where $3 \leq N \leq 10$

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Purpose:

1. To find the zeros (real and complex) of a polynomial of degree N , where $3 \leq N \leq 10$. The coefficients of the polynomial must be real, and the leading coefficient must be unity.
2. To reform the second (a_1) and the last (a_N) coefficient from the computed roots so that some indication of the accuracy will be given.

Program Description:

The program is based on Bairstow's Method which is described in:

- a) Introduction to Numerical Analysis, F.B. Hildebrand
McGraw-Hill, 1956, (page 472-476)
- b) Numerical Calculus, W.E. Milne
Princeton Univ. Press, 1949

Basically the program attempts to find quadratic factors ($X^2 + Px + Q$) that divide the original polynomial with a zero remainder. The following recursive equations are used to determine the final P and Q for each factor.

1. $b_i = a_i - Pb_{i-1} - Q b_{i-2} \quad 0 \leq i \leq N; (b_{-1} = b_{-2} = 0)$
2. $c_i = b_i - Pc_{i-1} - Q c_{i-2} \quad 0 \leq i \leq N; (c_{-1} = c_{-2} = 0)$
3. $C_{N-1} = - PC_{N-2} - QC_{N-3}$
4. $D = C_{N-2}^2 - C_{N-1} C_{N-3}$
5. $\Delta P = (b_{N-1} C_{N-2} - b_N C_{N-3}) / D$
6. $-\Delta Q = (b_{N-1} C_{N-1} - b_N C_{N-2}) / D$
7. $P' = P + \Delta P$
8. $Q' = Q - (-\Delta Q)$

When a set of P and Q are found the original polynomial is reduced and the process continues. The coefficients of the new polynomial are b_0, b_1, \dots, b_{N-2} .

Each iteration is continued until both $|P|$ and $|Q|$ are less than .000001.

Auxillary Programs Required:

1. Floating Point Interpretive System (24.0) in 0500_D.
2. Floating Point Data Input - Output (11.6-12.6) in 1500_D.
3. Floating Point Complex Operations (22.1) in 2200_D.

If the above programs are not stored in the locations listed it will be necessary to change this program as follows:

All XR0500-XU0500 sequences must be changed so that they will read XR and XU to the L_0 of the Floating Point Interpretive System.

All XR2200-XU2200 sequences must be changed so that they will read XR and XU to the L_0 of the Floating Point Complex Operations subroutine.

Limitations:

Closely spaced roots or multiple roots will cause D in equation 4 to be zero, and the division by zero stop in program 24.0 will be operative.

The calculation of the auxiliary quantities b_i and c_i may exceed the range of 24.0. This may be eliminated by rescaling the variable (i.e., let $x = 10y$).

Failure to converge will be indicated by the input light coming on. This is the floating print input; a new tolerance may be inserted into $L_0 + 0759$ and the program will continue. Alternately; try "Lin's Method".

No other restrictions are imposed upon the program. The method has some inherent restrictions but this author has not found a clear definition of these restrictions.

Operating Procedures:

See pages A and B attached.

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Input Format:

1. Store $a_0, a_1, a_2, \dots, a_N$ in floating point format starting in Lo + 0900. NOTE: $a_0 = 1$.
2. Store $N@ 29$. This must be placed on the data tape after the floating point data and in the form 0000000 N_H '. The program will store it in the proper location. Note that N_H is in hex, e.g., for a quintic, N_H is 00000014'.

Output Format:

1. The zeros of the polynomial in floating point format. The zeros will be in the form $A \pm Bi$.
2. The reformed ($-a_1$) and a_N will also be printed in the form $A + Bi$.

Total Storage:

Approximately $11\frac{1}{2}$ tracks.

0900 - 0910	Storage of the coefficients of the given polynomial.
0911 - 0921	Working cells for the coefficients.
0939 - 0934	Storage of the b's.
0939 - 0947	Storage of the c's.
0948	P (preliminary computations).
0949	Q (preliminary computations).
0950	ΔP
0951	ΔQ
0952	D
0953 - 1008	Real and complex parts of the roots.
1009 - 1018	P's and Q's (final results).

Running Time:

For 10th degree polynomials, time has ranged from 30 to 82 minutes.

PROGRAM OUTLINE

0000 - 0003 ---- Put Floating Pt. data in.
0832 - 0839 ---- Clear necessary locations.
0005 - 0006 ---- Fixed data (N @ 29).
0007 - 0038 ---- Form necessary flags and counters.
0038 - 0054 ---- Initialize addresses.
0100 - 0117 ---- Set coeff in work locations.
0118 - 0154 ---- Sequence to compute b_i 's.
0200 - 0236 ---- Sequence to compute c_i 's.
0237 - 0304 ---- Set up and compute c_{N-1} .
0305 - 0310 ---- Compute D.
0311 - 0317 ---- Compute ΔP .
0318 - 0324 ---- Compute $-\Delta Q$.
0326 - 0331 ---- Adjust P and Q.
0332 - 0344 ---- Compare ΔP and ΔQ with tolerance.
0345 - 0352 ---- Either ΔP and/or ΔQ out of tol-adjust iteration
counter and go back to 0118.
0352 - 0359 ---- Program has completed -- iterations --
Input light asking for new tolerance -- will repeat
(to 0118) after start compute.
0359 - 0405 ---- Set P and Q in work locations -- adjust addresses.
0406 - 0413 ---- Determine how many P and Q factors have been found.
0414 - 0415 ---- Only 1 root left-set P factor in proper work loc.
0416 - 0420 ---- All factors found - adjust necessary flags and go
to 0509.
0421 - 0429 ---- Only 1 set left - set P and Q factor in proper loc.
0430 - 0447 ---- More than 1 set of P and Q left -- move present b's
into a working and continue.
0448 - 0508 ---- Adjust necessary flags and counters - clear locations
and go back to 0118.

0509 - 0515 ---- Set up addresses to compute 1 pair of roots.

0516 - 0640 ---- Compute all roots and store them.

Sequence solves
$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

0640 - 0656 ---- Print out roots.

0657 - 0755 ---- Compute a_1 and a_N and print them out.

All other locations in the interval 0000 to 0839 that have not been listed are used to store permanent data, addresses, and temporary work locations. Approx. $1\frac{1}{2}$ track, starting at 0900, is used by the problem for the formation of all equations, P and Q factors and roots.

Sample Problem:

.0004000

Sample no. 1 - quartic with 4 real roots

+004900'

1'-0000010'35'-0000050'24'-0000000'

'

000000010'

.1999992 01 .0000000 00 .1000001 01 .0000000 00

.3999994 01 .0000000 00 .3000013 01 .0000000 00

.1000000 02 j.0000000 00 .2400000 02 j.0000000 00

.000400

Sample no. 2 - quartic with cyclic roots

+004900'

1'-0000000'

+024901'-0022220'448440'-0888800'160000'-0000000''

000000000010'

.2000000 01 .0000000 00 .2000000 00 .0000000 00

.2000000 03 .0000000 00 .2000000 02 .0000000 00

.2222000 03 j.0000000 00 .1600000 04 j.0000000 00

.0004000

Sample no. 3 - quartic with 2 pairs of complex roots

+044900'

10000'53990'677400'30880'144600'-0000000''

0000000000010'

.1436348- 01- .4630613 00 .1436348- 01- .4630613- 00

.2685136- 01 .7756361 01 .2685136- 01 .7756361- 01

.5399000- 01 j.0000000 00 .1446000 02 j.0000000 00

.0004000

Sample no. 4 - quartic with one coefficient missing

+004900'

1'15'15'10'-0000000'

'

0000000000010'

.3887328 00 .8526297 00 .3887328 00 .8526298- 00

.7582531- 00 .0000000 00 .1501921- 02 .0000000 00

.1500000- 02 j.0000000 00 .1000002 02 j.0000000 00

.0004000

Sample no. 5 - sixth order

4 complex 2 real

+034900'

1000'2399'53543'-0189334'140676'-0037204'28920'-0000000''

0000000000018'

.1436350- 01- .4630613 00 .1436350- 01- .4630613- 00

.2000000 01 .0000000 00 .1000000 01 .0000000 00

.2685137- 01 .7756360 01 .2685137- 01 .7756361- 01

.2399000- 01 j.0000000 00 .2892001 02 j.0000000 00

.0004000

Sample no. 6 - 10th order taken from POOL News - June 59

+014900'

10'-0000149'1145'-0004975'13956'-0025119'
49789'-0077147'70280'-0054750'37500'-0000000'

0000000000028'

.5141858- 01- .9879815 00 .5141858- 01- .9879816- 00

.1326428 01 .3902158 00 .1326428 01 .3902158- 00

.6305226- 00 .1718926 01 .6305226- 00 .1718927- 01

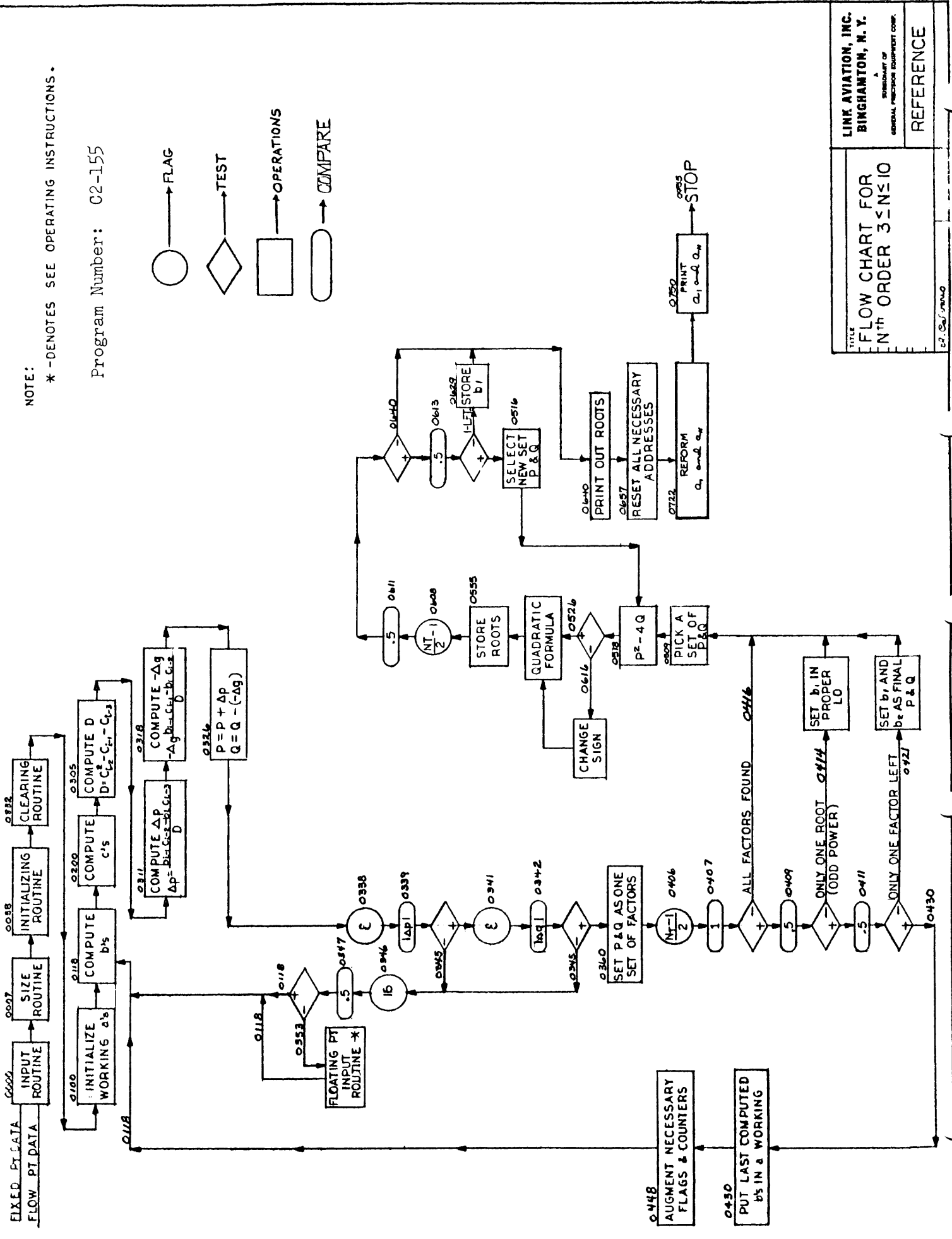
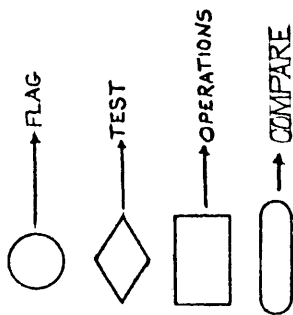
.2887559 01 .3883327 01 .2887559 01 .3883327- 01

.3917953 01 .3190556 01 .3917953 01 .3190556- 01

.1490000 02 j.0000000 00 .3750001 04 j.2555847- 03-

NOTE: * -DENOTES SEE OPERATING INSTRUCTIONS.

Program Number: C2-155



LINK AVIATION, INC. BINGHAMTON, N. Y.	SUBSIDIARY OF GENERAL PREDICTOR EQUIPMENT CORP.	TITLE
		FLOW CHART FOR N th ORDER 3 ≤ N ≤ 10
REFERENCE		SP. 201/31100

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
; 0 0 0 I o	/						
/ 0 0 0 I o	/	<input checked="" type="checkbox"/>					
		0 0 0 0	x R	0 5 0 0	/	} Enter Fl.Pt. System	
		0 1	x U	0 5 0 0	/		
		0 2	x I	0 0 0 0	/	Data Input	
		0 3	x E	0 0 0 0	/	<input checked="" type="checkbox"/> Exit Fl. Pt.	
		0 4	U	0 8 3 2	/	Clearing Routine	
		0 5			/		
		0 6			/		
		0 7	H	0 8 0 1	/	<input checked="" type="checkbox"/> Nt at 29	
		0 8	H	0 8 0 2	/	Np at 29	
		0 9	S	0 1 5 8	/	2 at 29	
		1 0	H	0 8 0 3	/	Nt-2 at 29	
		1 1	H	0 8 0 4	/	<input checked="" type="checkbox"/> Np-2 at 29	
		1 2	D	0 1 5 9	/	1 at 13	
		1 3	H	0 8 0 5	/	Nt-2 at 16	
		1 4	H	0 8 0 6	/	Np-2 at 16	
		1 5	A	0 1 6 0	/	<input checked="" type="checkbox"/> 1 at 16	
		1 6	H	0 8 0 7	/	Np-1 at 16	
		1 7	H	0 8 0 8	/	Nt-1 at 16	
		1 8	A	0 1 6 0	/	1 at 16	
		1 9	H	0 8 0 9	/	<input checked="" type="checkbox"/> Np at 16	
		2 0	H	0 8 1 0	/	Nt at 16	
		2 1	A	0 1 6 0	/	1 at 16	
		2 2	H	0 8 1 1	/	Nt+1 at 16	
		2 3	C	0 8 1 2	/	<input checked="" type="checkbox"/> Np+1 16	
		2 4	B	0 8 0 2	/	Np at 29	
		2 5	D	0 1 6 1	/	2 at 13	
		2 6	H	0 8 1 3	/	Np/2 at 16	
		2 7	C	0 8 1 4	/	<input checked="" type="checkbox"/> Nt/2 at 16	
		2 8	B	0 8 0 7	/	Np-1 at 16	
		2 9	D	0 1 6 3	/	2 at 2	
		3 0	M	0 1 6 2	/	1 at 2	
		3 1	H	0 8 1 5	/	<input checked="" type="checkbox"/> Np-1/2 at 16	

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 00	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	0 0 3 2	C	0 8 1 6	/	Nt-1 /2 at 16	
		3 3	B	0 8 0 9	/	Np at 16	
		3 4	A	0 8 0 9	/	Np at 16	
		3 5	S	0 1 6 0	/	1 at 16	
		3 6	H	0 8 1 7	/	2Np-1 at 16	
		3 7	C	0 8 1 8	/	2Nt-1 at 16	
		3 8	B	0 7 5 6	/	1009	
		3 9	Y	0 3 6 2	/	C()	
		4 0	B	0 7 5 7	/	1010	
		4 1	Y	0 4 0 0	/	C()	
		4 2	B	0 7 5 8	/	0953	
		4 3	Y	0 5 5 6	/	C()	
		4 4	A	0 1 5 7	/	4 h	
		4 5	Y	0 5 5 8	/	C()	
		4 6	A	0 1 5 7	/	4 H	
		4 7	Y	0 5 6 0	/	C()	
		4 8	A	0 1 5 7	/	4 H	
		4 9	Y	0 5 6 2	/	C()	
		5 0	U	0 1 0 0	/		
		5 1			/		
		5 2			/		
		5 3			/		
		5 4			/		
		5 5	Z	0 9 0 0	/	a ₀ P	
		5 6	Z	0 9 1 1	/	a ₀ T	
		5 7	Z	0 9 2 3	/	b-1	
		5 8	Z	0 9 2 2	/	b-2	
		5 9	Z	0 9 2 4	/	b ₀	
		6 0	Z	0 9 3 6	/	c-1	
		6 1	Z	0 9 3 5	/	c-2	
		6 2	Z	0 9 3 7	/	c ₀	
		6 3	Z	0 8 0 2	/	N at 29	

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 01	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 1 0 0	B	0 0 5 5	/	Lo a ₀	
		0 1	Y	0 1 0 8	/	B()	
		0 2	B	0 0 5 6	/	Lo a _w	
		0 3	Y	0 1 0 9	/	<input checked="" type="checkbox"/> C()	
		0 4	B	0 8 1 2	/	Np+1 at 16	
		0 5	S	0 1 6 0	/	l at 16	
		0 6	T	0 1 1 8	/		
		0 7	C	0 8 1 9	/	<input checked="" type="checkbox"/> counter	
		0 8	B	[]	/	a _i	
		0 9	C	[]	/	a _i work	
		1 0	B	0 1 0 8	/	B()	
		1 1	A	0 1 5 7	/	<input checked="" type="checkbox"/> 4 H	
		1 2	Y	0 1 0 8	/	B()	
		1 3	B	0 1 0 9	/	C()	
		1 4	A	0 1 5 7	/	4 H	
		1 5	Y	0 1 0 9	/	<input checked="" type="checkbox"/> C()	
		1 6	B	0 8 1 9	/	counter	
		1 7	U	0 1 0 5	/	→ not finished	
		1 8	B	0 0 5 8	/	L b-2	
		1 9	Y	0 1 3 3	/	<input checked="" type="checkbox"/> M()	
		2 0	B	0 0 5 7	/	Lo b-1	
		2 1	Y	0 1 3 6	/	M()	
		2 2	B	0 0 5 6	/	Lo a _{OT}	
		2 3	Y	0 1 3 8	/	<input checked="" type="checkbox"/> B()	
		2 4	B	0 0 5 9	/	Lo b ₀	
		2 5	Y	0 1 4 1	/	C()	
		2 6	B	0 8 1 1	/	Nt+1 at 16	
		2 7	S	0 1 6 0	/	<input checked="" type="checkbox"/> l at 16	
		2 8	T	0 2 0 0	/		
		2 9	C	0 8 1 9	/	counter	
		3 0	x R	0 5 0 0	/	} Enter Fl. Pt.	
		3 1	x U	0 5 0 0	/		<input checked="" type="checkbox"/>

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 01	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	0132	P	0949	/	Q	
		33	M	[]	/	bi-2	
		34	C	0155	/		Q bi-2
		35	P	0948	/	⊗ P	
		36	M	[]	/	bi-1	
		37	C	0156	/		P bi-1
		38	B	[]	/	a _i	
		39	S	0155	/	⊗ Q bi-2	
		40	S	0156	/	P bi-1	
		41	C	[]	/	bi	
		42	x E	0000	/	Exit Fl. Pt.	
		43	B	0138	/	⊗ B()	
		44	A	0157	/	4H	
		45	Y	0138	/	B()	
		46	B	0133	/	M()	
		47	A	0157	/	⊗ 4H	
		48	Y	0133	/	M()	
		49	A	0157	/	4H	
		50	Y	0136	/	M()	
		51	A	0157	/	⊗ 4H	
		52	Y	0141	/	C()	
		53	B	0819	/	counter	
		54	U	0127	/	→	not finished
,000 0009	/	55	[]		/	⊗	
		56	[]		/		
		57		4	/	1 at 29	
		58		8	/	2 at 29	
		59	4	0000	/	⊗ 1 at 13	
		60		8000	/	1 at 16	
		61	8	0000	/	2 at 13	
		62	2000	0000	/	1 at 2	
		63	4000	0000	/	⊗ 2 at 2	

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 02	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	X					
		0 2 0 0	B	0 0 6 1	/	Lo c-2	
		0 1	Y	0 2 1 5	/	M()	
		0 2	B	0 0 6 0	/	Lo c-1	
		0 3	Y	0 2 1 8	/	X M()	
		0 4	B	0 0 5 9	/	Lo b ₀	
		0 5	Y	0 2 2 0	/	B()	
		0 6	B	0 0 6 2	/	Lo c ₀	
		0 7	Y	0 2 2 3	/	X C()	
		0 8	B	0 8 0 8	/	Nt-1 at 16	
		0 9	S	0 1 6 0	/	1 at 16	
		1 0	T	0 2 3 7	/		
		1 1	C	0 8 1 9	/	X counter	
		1 2	x,R	0 5 0 0	/	} Enter fl. Pt.	
		1 3	x,U	0 5 0 0	/	}	
		1 4	P	0 9 4 9	/	Q	
		1 5	M	[]	/	X Ci-2	
		1 6	C	0 1 5 5	/		Q Ci-2
		1 7	P	0 9 4 8	/	P	
		1 8	M	[]	/	Ci-1	
		1 9	C	0 1 5 6	/	X	P Ci-1
		2 0	B	[]	/	bi	
		2 1	S	0 1 5 5	/	Q Ci-2	
		2 2	S	0 1 5 6	/	P Ci-1	
		2 3	C	[]	/	X Ci	
		2 4	x,E	0 0 0 0	/	Exit fl. pt.	
		2 5	B	0 2 2 0	/	B()	
		2 6	A	0 1 5 7	/	4 H	
		2 7	Y	0 2 2 0	/	X B()	
		2 8	B	0 2 1 5	/	M()	
		2 9	A	0 1 5 7	/	4H	
		3 0	Y	0 2 1 5	/	M()	
		3 1	A	0 1 5 7	/	X 4 H	

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 02	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 2 3 2	Y	0 2 1 8	/	M()	
		3 3	A	0 1 5 7	/	4H	
		3 4	Y	0 2 2 3	/	C()	
		3 5	B	0 8 1 9	/	<input checked="" type="checkbox"/> Counter	
		3 6	U	0 2 0 9	/	→ Not finished	
		3 7	B	0 0 6 0	/	Lo of C-1	
		3 8	A	0 8 0 3	/	Nt-2 at 29	
		3 9	Y	0 2 6 1	/	<input checked="" type="checkbox"/> M()	
		4 0	Y	0 3 0 6	/	M()	
		4 1	Y	0 3 1 1	/	P()	
		4 2	A	0 1 5 7	/	4H	
		4 3	Y	0 2 5 8	/	<input checked="" type="checkbox"/> M()	
		4 4	Y	0 3 0 8	/	P()	
		4 5	Y	0 3 0 9	/	N()	
		4 6	Y	0 3 1 4	/	P()	
		4 7	Y	0 3 1 8	/	<input checked="" type="checkbox"/> P()	
		4 8	B	0 0 5 7	/	Lo b-1	
		4 9	A	0 8 0 1	/	Nt at 29	
		5 0	Y	0 3 1 5	/	N()	
		5 1	Y	0 3 2 2	/	<input checked="" type="checkbox"/> N()	
		5 2	A	0 1 5 7	/	4H	
		5 3	Y	0 3 1 2	/	M()	
		5 4	Y	0 3 1 9	/	M()	
		5 5	x R	0 5 0 0	/	<input checked="" type="checkbox"/> } Enter Fl. Pt.	
		5 6	x U	0 5 0 0	/	}	
		5 7	P	0 9 4 8	/	P	
		5 8	M	[]	/	Cn-2	
		5 9	C	0 8 2 0	/	<input checked="" type="checkbox"/>	PCn-2
		6 0	P	0 9 4 9	/	Q	
		6 1	M	[]	/	Cn-3	
		6 2	T	0 3 0 1	/		
		6 3	x T	0 0 0 0	/	<input checked="" type="checkbox"/> -Q Cn-3	

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 03

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 3 0 0	U	0 3 0 2	/		
		0 1	x B	0 0 0 0	/	+ Q Cn-3	
		0 2	S	0 8 2 0	/	PCn-3	
		0 3	H	0 8 2 2	/	<input checked="" type="checkbox"/>	Cn-1
		0 4	C	0 8 2 1	/		Cn-1
		0 5	P	0 8 2 1	/	Cn-1	
		0 6	M	[]	/	Cn-3	
		0 7	x Y	0 0 0 0	/	<input checked="" type="checkbox"/>	-Cn-1 Cn-3
		0 8	P	[]	/	Cn-2	
		0 9	N	[]	/	Cn-2	
		1 0	C	0 9 5 2	/	D	
		1 1	P	[]	/	<input checked="" type="checkbox"/>	Cn-3
		1 2	M	[]	/	bn	
		1 3	x Y	0 0 0 0	/	-bn Cn-3	
		1 4	P	[]	/	Cn-2	
		1 5	N	[]	/	<input checked="" type="checkbox"/>	bn-1
		1 6	D	0 9 5 2	/	D	
		1 7	C	0 9 5 0	/	ΔP	
		1 8	P	[]	/	Cn-2	
		1 9	M	[]	/	<input checked="" type="checkbox"/>	bn
		2 0	x Y	0 0 0 0	/	-bn Cn-2	
		2 1	P	0 8 2 1	/	Cn-1	
		2 2	N	[]	/	bn-1	
		2 3	D	0 9 5 2	/	<input checked="" type="checkbox"/>	D
		2 4	C	0 9 5 1	/	$-\Delta Q$	
		2 5	U	0 3 2 6	/		
		2 6	B	0 9 4 8	/	P	
		2 7	A	0 9 5 0	/	<input checked="" type="checkbox"/>	ΔP
		2 8	C	0 9 4 8	/	P	
		2 9	B	0 9 4 9	/	Q	
		3 0	S	0 9 5 1	/	$-\Delta Q$	
		3 1	C	0 9 4 9	/	<input checked="" type="checkbox"/>	Q

CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

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JOB NO.	PROGRAM NO. G2-155	PROGRAM PREPARED BY G.P. Becker	PROGRAM CHECKED BY: POOL Review	DATE 12/09/59	
PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 03	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 3 3 2	B	0 9 5 0	/	ΔP	
		3 3	x B	0 0 0 0	/	/ ΔP /	
		3 4	C	0 8 2 0	/	/ ΔP /	
		3 5	B	0 9 5 1	/	<input checked="" type="checkbox"/> ΔQ	
		3 6	x B	0 0 0 0	/	/ ΔQ /	
		3 7	C	0 8 2 1	/	/ ΔQ /	
		3 8	B	0 7 5 9	/	Tol	
		3 9	S	0 8 2 0	/	<input checked="" type="checkbox"/> / ΔP /	
		4 0	T	0 3 4 5	/	Reject P and Q	
		4 1	B	0 7 5 9	/	Tol	
		4 2	S	0 8 2 1	/	/ ΔQ /	
		4 3	T	0 3 4 5	/	<input checked="" type="checkbox"/> Reject P and Q	
		4 4	U	0 3 6 0	/	Accept P and Q	
		4 5	x E	0 0 0 0	/	Exit Fl. Pt.	
		4 6	B	0 7 6 1	/	Iteration counter (16)	
		4 7	S	0 7 6 2	/	<input checked="" type="checkbox"/> .5	
		4 8	T	0 3 5 3	/		
		4 9	B	0 7 6 2	/	counter	
		5 0	A	0 7 6 0	/	.5	
		5 1	C	0 7 6 2	/	<input checked="" type="checkbox"/> counter	
		5 2	U	0 1 1 8	/	→ Not finished	
		5 3	x R	0 5 0 0	/	Change tol	} Enter Fl. Pt.
		5 4	x U	0 5 0 0	/		
		5 5	x I	0 0 0 0	/	<input checked="" type="checkbox"/>	Data Input
		5 6	x E	0 0 0 0	/		Exit Fl. Pt.
		5 7	B	0 7 6 0	/	.5	
		5 8	C	0 7 6 2	/	Iteration counter	
		5 9	U	0 3 5 2	/	<input checked="" type="checkbox"/> → not finished	
		6 0	x E	0 0 0 0	/		Exit Fl. Pt.
		6 1	B	0 9 4 8	/	P	Store as
		6 2	C	[]	/		Factor
		6 3	B	0 9 4 9	/	<input checked="" type="checkbox"/> Q	" " "

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JOB NO.	PROGRAM NO. C2-155	PROGRAM PREPARED BY: G.P. Becker	PROGRAM CHECKED BY: POOL Review	DATE 12/09/59	
PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 04	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		04 0 0	C	[]	/		
		0 1	B	0362	/	C()	
		0 2	A	0158	/	8H	
		0 3	Y	0362	/	<input checked="" type="checkbox"/> C()	
		0 4	A	0157	/	4H	
		0 5	Y	0400	/	C()	
		0 6	B	0816	/	$\frac{Nt-1}{2}$ at 16	
		0 7	S	0160	/	<input checked="" type="checkbox"/> 1 at 16	
		0 8	T	0416	/	All factors found	
		0 9	S	0760	/	.5 at 16	
		1 0	T	0414	/	Only 1 root → Set P in work	
		1 1	S	0760	/	<input checked="" type="checkbox"/> .5 at 16	
		1 2	T	0421	/	Only 1 factor → Set P and Q in work	
		1 3	U	0430	/	More than 1 set left	
		1 4	B	0925	/	Bring last b_1	
		1 5	C	0849	/	<input checked="" type="checkbox"/> Clear as P	
		1 6	B	0810	/	Nt at 16	
		1 7	A	0810	/	Nt at 16	
		1 8	S	0160	/	1 at 16	
		1 9	C	0818	/	<input checked="" type="checkbox"/> 2Nt-1 at 16	
		2 0	U	0509	/	Go to compute roots	
		2 1	B	0362	/	C()	
		2 2	Y	0426	/	Set to store final P	
		2 3	B	0400	/	<input checked="" type="checkbox"/> C()	
		2 4	Y	0428	/	Set to store final Q	
		2 5	B	0925	/	Bring b_1	
		2 6	C	[]	/	Store as final P	
		2 7	B	0926	/	<input checked="" type="checkbox"/> Bring b_2	
		2 8	C	[]	/	Store as final Q	
		2 9	U	0416	/		
		3 0	B	0059	/	Lo of b_0	
		3 1	Y	0438	/	<input checked="" type="checkbox"/> B()	

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JOB NO.	PROGRAM NO. C2-155	PROGRAM PREPARED BY G.P. Becker	PROGRAM CHECKED BY: POOL Review	DATE 12/09/59
PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 04

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 4 3 2	B	0 0 5 6	/	Lo of a ₀	work
		3 3	Y	0 4 3 9	/	C()	
		3 4	B	0 8 0 8	/	Nt-1 at 16	
		3 5	S	0 1 6 0	/	<input checked="" type="checkbox"/> 1 at 16	
		3 6	T	0 4 4 8	/		
		3 7	C	0 8 1 9	/	counter	
		3 8	B	[]	/	b _i	
		3 9	C	[]	/	<input checked="" type="checkbox"/> a _i	
		4 0	B	0 4 3 8	/	B()	
		4 1	A	0 1 5 7	/	4H	
		4 2	Y	0 4 3 8	/	B()	
		4 3	B	0 4 3 9	/	<input checked="" type="checkbox"/> C()	
		4 4	A	0 1 5 7	/	4H	
		4 5	Y	0 4 3 9	/	C()	
		4 6	B	0 8 1 9	/	Counter	
		4 7	U	0 4 3 5	/	<input checked="" type="checkbox"/> →	Not finished
		4 8	B	0 8 1 0	/	Nt at 16	
		4 9	S	0 3 0 1	/	XB0000 \approx	2 at 16
		5 0	H	0 8 1 0	/	Nt at 16	
		5 1	S	0 1 6 0	/	<input checked="" type="checkbox"/> 1 at 16	
		5 2	H	0 8 0 8	/	Nt-1 at 16	
		5 3	S	0 1 6 0	/	1 at 16	
		5 4	C	0 8 0 5	/	Nt-2 at 16	
		5 5	B	0 8 0 8	/	<input checked="" type="checkbox"/> Nt-1 at 16	
		5 6	D	0 1 6 3	/	2 at 2	
		5 7	M	0 1 6 2	/	1 at 2	
		5 8	C	0 8 1 6	/	$\frac{Nt-1}{2}$ at 16	
		5 9	C	0 9 4 8	/	<input checked="" type="checkbox"/> Set P=0	
		6 0	C	0 9 4 9	/	Set Q=0	
		6 1	C	0 9 5 0	/	Set ΔP=0	
		6 2	C	0 9 5 1	/	Set ΔQ=0	
		6 3	U	0 5 0 1	/	<input checked="" type="checkbox"/>	

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 05

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		05 000	(
		01	B	0760		.5 at 16	
		02	C	0762		.5 at 16	
		03	B	0801	<input checked="" type="checkbox"/>	Nt at 29	
		04	S	0158		8H	
		05	H	0801		Nt at 29	
		06	S	0158		8H	
		07	H	0803	<input checked="" type="checkbox"/>	Nt-2 at 29	
		08	U	0118		→	Not finished
		09	B	0756		Lo of 1st	P factor
		10	Y	0521		P()	
		11	Y	0522	<input checked="" type="checkbox"/>	M()	
		12	Y	0529		B()	
		13	Y	0622		B()	
		14	B	0757		Lo of 1st	Q factor
		15	Y	0518	<input checked="" type="checkbox"/>	B()	
		16	x R	0500		Enter Fl.	Pt.
		17	x U	0500			
		18	B	[]		Q	
		19	x M	0002	<input checked="" type="checkbox"/>	4	
		20	C	0820			4Q
		21	P	[]		P	
		22	M	[]		P	
		23	S	0820	<input checked="" type="checkbox"/>	4Q	
		24	H	0821			P^2-4Q
		25	T	0616		Complex	Roots
		26	x R	0000		$\sqrt{P^2-4Q}$	
		27	x D	0001	<input checked="" type="checkbox"/>	$\sqrt{P^2-4Q}/2$	
		28	H	0822			$\sqrt{P^2-4Q}/2$
		29	B	[]		P	
		30	x D	0001		2	
		31	x Y	0000	<input checked="" type="checkbox"/>	-P/2	

CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

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JOB NO.	PROGRAM NO. C2-155	PROGRAM PREPARED BY: G.P. Becker	PROGRAM CHECKED BY: POOL Review	DATE 12/09/59	
PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 05	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 5 3 2	H	0 8 2 3	/		-P/2
		3 3	A	0 8 2 2	/	$\sqrt{P^2-4Q}/2$	
		3 4	C	0 8 2 4	/		Real Root
		3 5	B	0 8 2 3	/	<input checked="" type="checkbox"/> -P/2	
		3 6	S	0 8 2 2	/	$\sqrt{P^2-4Q}/2$	
		3 7	C	0 8 2 5	/		Real Root
		3 8	x,E	0 0 0 0	/	Exit Fl. Pt.	
		3 9	C	0 8 0 0	/	<input checked="" type="checkbox"/> Clear accumulator	
		4 0	C	0 8 2 6	/	Set imaginary part = 0	
		4 1	C	0 8 2 7	/	" " " = 0	
		4 2	B	0 5 2 9	/	B()	
		4 3	A	0 1 5 8	/	<input checked="" type="checkbox"/> 8H	
		4 4	Y	0 5 2 9	/	B()	
		4 5	B	0 5 1 8	/	B()	
		4 6	A	0 1 5 8	/	8H	
		4 7	Y	0 5 1 8	/	<input checked="" type="checkbox"/> B()	
		4 8	B	0 5 2 1	/	P()	
		4 9	A	0 1 5 8	/	8H	
		5 0	Y	0 5 2 1	/	P()	
		5 1	Y	0 5 2 2	/	<input checked="" type="checkbox"/> M()	
		5 2	Y	0 6 2 2	/	B()	
		5 3	U	0 5 5 5	/		
0 0 0 0 0 0 1	/	5 4		1 0	/		
		5 5	B	0 8 2 4	/	<input checked="" type="checkbox"/> Real Part	
		5 6	C	[]	/		
		5 7	B	0 8 2 6	/	Imaginary Part	
		5 8	C	[]	/		
		5 9	B	0 8 2 5	/	<input checked="" type="checkbox"/> Real Part	
		6 0	C	[]	/		
		6 1	B	0 8 2 7	/	Imaginary Part	
		6 2	C	[]	/		
		6 3	B	0 5 5 6	/	<input checked="" type="checkbox"/> C()	

CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

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JOB NO.	PROGRAM NO. C2-155	PROGRAM PREPARED BY: G.P. Becker	PROGRAM CHECKED BY: POOL Review	DATE 12/09/59
PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0,6,0,0	A	0554	/	10H	
		0,1	Y	0556	/	C()	
		0,2	A	0157	/	4H	
		0,3	Y	0558	/	<input checked="" type="checkbox"/> C()	
		0,4	A	0157	/	4H	
		0,5	Y	0560	/	C()	
		0,6	A	0157	/	4H	
		0,7	Y	0562	/	<input checked="" type="checkbox"/> C()	
		0,8	B	0814	/	Nt/2 at 16	
		0,9	S	0160	/	1 at 16	
		1,0	H	0814	/	Nt/2 at 16	
		1,1	S	0760	/	<input checked="" type="checkbox"/> .5 at 16	
		1,2	T	0640	/	all roots computed	
		1,3	S	0760	/	.5 at 16	
		1,4	T	0629	/	Only 1 root left	
		1,5	U	0516	/	<input checked="" type="checkbox"/> More than 1 left	
		1,6	x B	0000	/	Make P^2-4Q Positive	
		1,7	x R	0000	/	$\sqrt{P^2-4Q}$	
		1,8	x D	0001	/	$\sqrt{P^2-4Q}/2$	
		1,9	H	0826	/	<input checked="" type="checkbox"/> 1st Imaginary Part	
		2,0	x Y	0000	/	Change Sign	
		2,1	C	0827	/	2nd imaginary part	
		2,2	B	[]	/	P	
		2,3	X D	0001	/	<input checked="" type="checkbox"/> 2	
		2,4	x Y	0000	/	-P/2	
		2,5	H	0824	/	1st Real Part	
		2,6	C	0825	/	2nd real part	
		2,7	x E	0000	/	<input checked="" type="checkbox"/> exit fl. pt	
		2,8	U	0542	/	Go to store roots	
		2,9	B	0562	/	C()	
		3,0	S	0801	/	Nt at 29	
		3,1	Y	0639	/	<input checked="" type="checkbox"/> C()	

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CARRIAGE RETURN
 / = CONDITIONAL STOP CODE

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JOB NO.	PROGRAM NO. G2-155	PROGRAM PREPARED BY: G.P. Becker	PROGRAM CHECKED BY: POOL Review	DATE 12/09/59	
PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 06	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 6 3 2	x R	0 5 0 0	/	} Enter Fl. Pt.	
		3 3	x U	0 5 0 0	/	}	
		3 4	B	0 8 4 9	/	bl	
		3 5	x Y	0 0 0 0	/	<input checked="" type="checkbox"/> -bl	
		3 6	C	0 8 2 3	/		-b.
		3 7	x E	0 0 0 0	/	Exit Fl. Pt.	
		3 8	U	0 8 5 0	/		
		3 9	C	[]	/	<input checked="" type="checkbox"/> Store as single roots	
		4 0	B	0 7 5 8	/	Lo of lst root	
		4 1	Y	0 6 4 9	/	B()	
		4 2	B	0 8 1 7	/	2Np-1 at 16	
		4 3	A	0 1 6 0	/	<input checked="" type="checkbox"/> 1 at 16	
		4 4	S	0 1 6 0	/	1 at 16	
		4 5	T	0 6 5 7	/		
		4 6	C	0 8 1 9	/	counter	
		4 7	x R	0 5 0 0	/	<input checked="" type="checkbox"/> } Enter Fl. Pt.	
		4 8	x U	0 5 0 0	/	}	
		4 9	B	[]	/	Root	
		5 0	x P	0 0 0 0	/	Print	
		5 1	x E	0 0 0 0	/	<input checked="" type="checkbox"/> Exit Fl. Pt.	
		5 2	B	0 6 4 9	/	B()	
		5 3	A	0 1 5 7	/	4H	
		5 4	Y	0 6 4 9	/	B()	
		5 5	B	0 8 1 9	/	<input checked="" type="checkbox"/> counter	
		5 6	U	0 6 4 4	/	→ Not finished	
		5 7	x P	1 6 0 0	/	"C.R."	
		5 8	Z	1 0 5 0	/	Delay	
		5 9	B	0 7 5 8	/	<input checked="" type="checkbox"/> Lo of lst Root	
		6 0	Y	0 5 5 6	/	C()	Restore address
		6 1	A	0 1 5 7	/	4H	
		6 2	Y	0 5 5 8	/	C()	
		6 3	A	0 1 5 7	/	<input checked="" type="checkbox"/> 4H	

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CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

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JOB NO.	PROGRAM NO. C2-155	PROGRAM PREPARED BY: G.P. Becker	PROGRAM CHECKED BY: POOL Review
PROBLEM: Nth Order $3 \leq N \leq 10$			DATE 12/09/59
			TRACK 07

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0,7,0,0	Y	0560	/	C()	Restore addresses
		0,0,1	A	0157	/	4H	
		0,0,2	Y	0562	/	C()	
		0,0,3	B	0056	/	<input checked="" type="checkbox"/> Lo of a ₀	work
		0,0,4	Y	0439	/	C()	
		0,0,5	B	0059	/	Lo of b ₀	
		0,0,6	Y	0438	/	B()	
		0,0,7	B	0756	/	<input checked="" type="checkbox"/> Lo of 1st P	
		0,0,8	Y	0362	/	C()	
		0,0,9	B	0757	/	Lo of 1st Q	
		1,1,0	Y	0400	/	C()	
		1,1,1	B	0758	/	<input checked="" type="checkbox"/> Lo of 1st Root	
		1,1,2	Y	0723	/	A()	
		1,1,3	Y	0737	/	B()	
		1,1,4	A	0158	/	8H	
		1,1,5	Y	0738	/	<input checked="" type="checkbox"/> M()	
		1,1,6	B	0809	/	Np at 16	
		1,1,7	S	0160	/	l at 16	
		1,1,8	T	0731	/	Finished Σ Roots	
		1,1,9	C	0819	/	<input checked="" type="checkbox"/> counter	
		2,2,0	x R	2200	/	Complex Operations	
		2,2,1	x U	2200	/		
		2,2,2	B	0828	/	work = Σ roots	
		2,2,3	A	[]	/	<input checked="" type="checkbox"/> r ₁ , r ₂ , r ₃ , etc.	
		2,2,4	C	0828	/	Σ roots	
		2,2,5	x E	0000	/	Exit complex oper.	
		2,2,6	B	0723	/	B()	
		2,2,7	A	0158	/	<input checked="" type="checkbox"/> 8H	
		2,2,8	Y	0723	/	B()	
		2,2,9	B	0819	/	counter	
		3,3,0	U	0717	/	→	Not finished
		3,3,1	B	0807	/	<input checked="" type="checkbox"/> Np-1 at 16	

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PROBLEM: Nth Order $3 \leq N \leq 10$			TRACK 07	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 7 3 2	S	0 1 6 0	/	1 at 16	
		3 3	T	0 7 4 8	/	finished product of roots	
		3 4	C	0 8 1 9	/	counter	
		3 5	x R	2 2 0 0	/	<input checked="" type="checkbox"/> } Complex oper	
		3 6	x U	2 2 0 0	/	}	
		3 7	B	[]	/	Product of roots unit = 0	
		3 8	M	[]	/	r1, r2, r3 etc	
		3 9	C	0 8 3 0	/	<input checked="" type="checkbox"/> Product of roots	
		4 0	x E	0 0 0 0	/	Exit complex oper.	
		4 1	B	0 7 3 9	/	C0830	
		4 2	Y	0 7 3 7	/	B()	
		4 3	B	0 7 3 8	/	<input checked="" type="checkbox"/> M()	
		4 4	A	0 1 5 8	/	8H	
		4 5	Y	0 7 3 8	/	M()	
		4 6	B	0 8 1 9	/	counter	
		4 7	U	0 7 3 2	/	<input checked="" type="checkbox"/> → Not finished	
		4 8	x R	2 2 0 0	/	} Complex	
		4 9	x U	2 2 0 0	/	}	
		5 0	B	0 8 2 8	/	Σ root = -a1	
		5 1	x P	0 0 0 0	/	<input checked="" type="checkbox"/> Print	
		5 2	B	0 8 3 0	/	Prod. of roots = a _n	
		5 3	x P	0 0 0 0	/	Print	
		5 4	x E	0 0 0 0	/	Exit complex oper	
		5 5	Z	0 0 0 0	/	<input checked="" type="checkbox"/> Stop	
		5 6	Z	1 0 0 9	/	Lo of 1st P	
		5 7	Z	1 0 1 0	/	Lo of 1st Q	
		5 8	Z	0 9 5 3	/	Lo of 1st Root	
, 0 0 0 0 0 0 0 4	/	5 9	4 3 1 G K W 5 F		/	<input checked="" type="checkbox"/> Tolerance	
		6 0		4 0 0 0	/	.5 at 16	
		6 1	W	0 0 0 0	/		
		6 2	1	0 0 0 0	/		
		6 3	Z	1 0 4 9	/	<input checked="" type="checkbox"/>	

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PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 08	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/						
	/	<input checked="" type="checkbox"/>					
		0 8 0 0			/	Garbage	
		0 1			/	Nt at 29	
		0 2			/	Np at 29	
		0 3			/	<input checked="" type="checkbox"/> Nt-2 at 29	
		0 4			/	Np-2 at 29	
		0 5			/	Nt-2 at 16	
		0 6			/	Np-2 at 16	
		0 7			/	<input checked="" type="checkbox"/> Np-1 at 16	
		0 8			/	Nt-1 at 16	
		0 9			/	Np at 16	
		1 0			/	Nt at 16	
		1 1			/	<input checked="" type="checkbox"/> Nt+1 at 16	
		1 2			/	Np+1 at 16	
		1 3			/	Np/2 at 16	
		1 4			/	Nt/2 at 16	
		1 5			/	<input checked="" type="checkbox"/> $\frac{Np-1}{2}$ at 16	
		1 6			/	$\frac{Nt-1}{2}$ at 16	
		1 7			/	2Np-1 at 16	
		1 8			/	2Nt-1 at 16	
		1 9			/	<input checked="" type="checkbox"/> counter	
		2 0			/	work	
		2 1			/	"	
		2 2			/	"	
		2 3			/	<input checked="" type="checkbox"/> "	
		2 4			/	"	
		2 5			/	"	
		2 6			/	"	
		2 7			/	<input checked="" type="checkbox"/> "	
		2 8			/	"	
		2 9			/	"	
		3 0			/	"	
		3 1			/	<input checked="" type="checkbox"/> "	

Royal McBee Corporation
 DATA PROCESSING DIV.
 PORT CHESTER, NEW YORK

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JOB NO.	PROGRAM NO. C2-155	PROGRAM PREPARED BY: G.P. Becker	PROGRAM CHECKED BY: POOL Review	DATE 12/09/59	
PROBLEM: Nth Order $3 \leq N \leq 10$				TRACK 08	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
	/				/		
	/	<input checked="" type="checkbox"/>			/		
		Q 8,3 2	C	0 8,0 0	/		
		3 3	x P	0 0,0 0	/		
		3 4	x I	0 0,0 0	/		
		3 5	C	0 8,0 0	/	<input checked="" type="checkbox"/>	
		3 6	C	0 9,4 8	/		
		3 7	C	0 9,4 9	/		
		3 8	C	0 8,2 8	/		
		3 9	C	0 8,2 9	/	<input checked="" type="checkbox"/>	
		4 0	C	0 8,3 0	/		
		4 1	C	0 8,3 1	/		
		4 2	C	0 9,2 2	/		
		4 3	C	0 9,2 3	/	<input checked="" type="checkbox"/>	
		4 4	C	0 9,3 5	/		
		4 5	C	0 9,3 6	/		
		4 6	B	0 8,0 0	/		
		4 7	U	0 0,0 7	/	<input checked="" type="checkbox"/>	
		4 8	()	/		
		4 9	()	/		
		5 0	B	0 6,3 9	/		
		5 1	A	0 1,5 7	/	<input checked="" type="checkbox"/>	
		5 2	Y	0 8,5 4	/		
		5 3	C	0 8,0 0	/		
		5 4	C	()	/		
		5 5	B	0 8,2 3	/	<input checked="" type="checkbox"/>	
		5 6	U	0 6,3 9	/		
		5 7			/		
		5 8			/		
		5 9			/	<input checked="" type="checkbox"/>	
		6 0			/		
		6 1			/		
		6 2			/		
		6 3			/	<input checked="" type="checkbox"/>	