

HP-41C Rubik's Cube Solver X by Julian Perry
PPC Calculator Journal Vol 9 N2 P23 Mar 1982
Includes changes by Gessler NOP PPC V10N4P3.

```
01 LBL "X"      ;Initialize R01-R04 X Axis
02 3
03 STO 01
04 STO 02
05 STO 03
06 -9
07 STO 04
08 RTN
09 LBL "Y"      ;Initialize R01-R04 Y Axis
10 6
11 STO 01
12 STO 02
13 CHS
14 STO 03
15 STO 04
16 RTN
17 LBL "Z"      ;Initialize R01-R04 Z Axis
18 9
19 STO 01
20 -3
21 STO 02
22 STO 03
23 STO 04
24 RTN
25 LBL "T"      ;Calculate Next Move
26 LBL 00
27 INT
28 X=0?
29 RTN
30 LASTX
31 FRC
32 E2
33 *
34 STO 10
35 X<>Y
36 RCL X
37 1
38 ST+ 14
39 -
40 3
41 /
42 X<>Y
43 RCL IND Y
44 +
45 6
46 +
47 XEQ IND X
48 RCL 10
49 DSE 15
50 GTO 00
51 FS? 55
52 SF 21
53 XEQ "S"      ;Display/Printer Subroutine (R Line 615, R2 Line 505)
54 AVIEW
55 12
56 STO 15
57 CLA
58 RCL 10
59 GTO 00
60 LBL 07
61 >"D,"      ;Rotate Down Face Counterclockwise 1/4 Turn
62 3
63 GTO 01
64 LBL 08
65 >"D:"      ;Rotate Down Face Through a Half Turn
66 2
```

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67 GTO 01
68 LBL 09
69 >"D"      ;Rotate Down Face Clockwise 1/4 Turn
70 1
71 LBL 01
72 RCL 16
73 X<> 19
74 X<> 18
75 X<> 17
76 X<> 16
77 X<> 24
78 X<> 27
79 X<> 26
80 X<> 25
81 STO 24
82 X<>Y
83 DSE X
84 GTO 01
85 RTN
86 LBL 10
87 >"F,"      ;Rotate Front Face Counterclockwise 1/4 Turn
88 3
89 GTO 02
90 LBL 11
91 >"F:"      ;Rotate Front Face Through a Half Turn
92 2
93 GTO 02
94 LBL 12
95 >"F"      ;Rotate Down Face Clockwise 1/4 Turn
96 1
97 LBL 02
98 INT
99 RCL 16
100 X<> 17
101 X<> 21
102 X<> 20
103 STO 16
104 RCL 24
105 X<> 29
106 X<> 32
107 X<> 28
108 STO 24
109 1
110 ST- 16
111 ST+ 17
112 ST- 21
113 ST+ 20
114 ST+ 28
115 ST+ 24
116 LASTX
117 DSE X
118 GTO 02
119 RTN
120 LBL 13
121 >"L,"      ;Rotate Left Face Counterclockwise 1/4 Turn
122 3
123 GTO 03
124 LBL 14
125 >"L:"      ;Rotate Left Face Through a Half Turn
126 2
127 GTO 03
128 LBL 15
129 >"L"      ;Rotate Left Face Clockwise 1/4 Turn
130 1
131 LBL 03
132 INT
133 RCL 17
134 X<> 18
135 X<> 22
136 X<> 21

```

```

137 STO 17
138 RCL 25
139 X<> 30
140 X<> 33
141 X<> 29
142 STO 25
143 1
144 ST- 17
145 ST+ 18
146 ST- 22
147 ST+ 21
148 ST+ 29
149 ST+ 25
150 LASTX
151 DSE X
152 GTO 03
153 RTN
154 LBL 16
155 >"B," ;Rotate Bottom Face Counterclockwise 1/4 Turn
156 3
157 GTO 04
158 LBL 17
159 >"B:" ;Rotate Bottom Face Through a Half Turn
160 2
161 GTO 04
162 LBL 18
163 >"B" ;Rotate Bottom Face Clockwise 1/4 Turn
164 1
165 LBL 04
166 INT
167 RCL 18
168 X<> 19
169 X<> 23
170 X<> 22
171 STO 18
172 RCL 26
173 X<> 31
174 X<> 34
175 X<> 30
176 STO 26
177 1
178 ST- 18
179 ST+ 19
180 ST- 23
181 ST+ 22
182 ST+ 30
183 ST+ 26
184 LASTX
185 DSE X
186 GTO 04
187 RTN
188 LBL 19
189 >"R," ;Rotate Right Face Counterclockwise 1/4 Turn
190 3
191 GTO 05
192 LBL 20
193 >"R:" ;Rotate Right Face Through a Half Turn
194 2
195 GTO 05
196 LBL 21
197 >"R" ;Rotate Right Face Clockwise 1/4 Turn
198 1
199 LBL 05
200 INT
201 RCL 19
202 X<> 16
203 X<> 20
204 X<> 23
205 STO 19
206 RCL 27

```

```

207 X<> 28
208 X<> 35
209 X<> 31
210 STO 27
211 1
212 ST- 19
213 ST+ 16
214 ST- 20
215 ST+ 23
216 ST+ 31
217 ST+ 27
218 LASTX
219 DSE X
220 GTO 05
221 RTN
222 LBL 22
223 >"U,"      ;Rotate Up Face Counterclockwise 1/4 Turn
224 3
225 GTO 06
226 LBL 23
227 >"U:"      ;Rotate Up Face Through a Half Turn
228 2
229 GTO 06
230 LBL 24
231 >"U"      ;Rotate Up Face Clockwise 1/4 Turn
232 1
233 LBL 06
234 RCL 20
235 X<> 21
236 X<> 22
237 X<> 23
238 X<> 20
239 X<> 32
240 X<> 33
241 X<> 34
242 X<> 35
243 STO 32
244 X<>Y
245 DSE X
246 GTO 06
247 END      ;446 BYTES

```

```

01BEC000F20058133132331C193485C000F200591631325433
3485C000F2005A19311C1332333485C000F200540168678576
691B12423A71907311920E4113437190F2401640AEF32A970F
B100AC37A8151EF1537E11123F872AB10008F37F442C13B200
09F37F443A12B2000AF27F4411029010CE13CE12CE11CE10CE
18CE1BCE1ACE199118719773B200850BF37F462C13B3000CF3
7F463A12B3000DF27F461103689010CE11CE15CE1491109018
CE1DCE20CE1C9118119310921193159214921C9218769773B3
00850EF37F4C2C13B4000FF37F4C3A12B400CF0FF27F4C1104
689011CE12CE16CE1591119019CE1ECE21CE1D911911931192
1293169215921D9219769773B40085CF10F37F422C13B500CF
11F37F423A12B500CF12F27F421105689012CE13CE17CE1691
12901ACE1FCE22CE1E911A119312921393179216921E921A76
9773B50085CF13F37F522C13B600CF14F37F523A12B600CF15
F27F521106689013CE10CE14CE179113901BCE1CCE23CE1F91
1B119313921093149217921F921B769773B60085CF16F37F55
2C13B700CF17F37F553A12B700CF18F27F5511079014CE15CE
16CE17CE14CE20CE21CE22CE239120719773B700C0000D5F

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HP-41C Rubik's Cube Solver R by Julian Perry
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```
01 LBL "R"      ;Rubik's Cube Solver - Part 1
02 CF 21
03 FS? 55
04 SF 21
05 CF 28
06 CF 29
07 FIX 0
08 CLRG
09 ADV
10 .203221
11 ADV
12 .280229
13 "F"
14 .162417
15 XEQ 50
16 .213322
17 "L"
18 .29033
19 ADV
20 .172518
21 XEQ 50
22 .223423
23 "B"
24 .300431
25 ADV
26 .182619
27 XEQ 50
28 .23352
29 "R"
30 .310528
31 ADV
32 .192716
33 XEQ 50
34 .162417
35 "D"
36 .270125
37 ADV
38 .192618
39 XEQ 50
40 .233422
41 "U"
42 .350633
43 ADV
44 .203221
45 XEQ 50
46 AOFF
47 16.023
48 STO 00
49 GTO 60
50 LBL 50
51 >"FACE"
52 ASTO 00
53 STO 13
54 RDN
55 STO 12
56 RDN
57 STO 11
58 11.013
59 STO 15
60 LBL 51
61 RCL IND 15
62 STO 07
63 CLA
64 ARCL 00
65 >"ROW "
66 RCL 15
```

```

67 10
68 -
69 ARCL X
70 FS? 55
71 XROM 29,01 ;ACA
72 AON
73 TONE 6
74 PROMPT
75 ASTO 09
76 ": " ;1 colon, 2 spaces
77 ARCL 09
78 ASTO 09
79 CLA
80 ARCL 09
81 FS? 55
82 XROM 29,01 ;ACA
83 FS? 55
84 XROM 29,10 ;PRBUF
85 3
86 STO 08
87 LBL 52
88 "*" ;1 asterisk
89 ARCL 09
90 ASTO 09
91 ASHF
92 RCL 07
93 1 E2
94 *
95 FRC
96 STO 07
97 LASTX
98 RCL IND X
99 SIGN
100 X=0?
101 ARCL L
102 ASTO IND Y
103 DSE 08
104 GTO 52
105 ISG 15
106 GTO 51
107 RTN
108 LBL 68
109 CF 05
110 CF 07
111 CF 08
112 16
113 RCL 00
114 INT
115 X=Y?
116 SF 05
117 20
118 X<Y?
119 SF 05
120 "*****" ;4 asterisks
121 ARCL IND 00
122 ASTO L
123 ASHF
124 ASTO Y
125 "*" ;1 asterisk
126 ARCL L
127 ASTO L
128 ASHF
129 ASTO X
130 "*" ;1 asterisk
131 ARCL L
132 ASHF
133 ASTO 07
134 FS? 05
135 X<>Y
136 STO 08

```

```
137 X<>Y
138 STO 09
139 7.009
140 STO 11
141 LBL 61
142 6
143 STO 12
144 LBL 62
145 RCL IND 12
146 RCL IND 11
147 X=Y?
148 GTO 00
149 DSE 12
150 GTO 62
151 "ERROR"
152 PROMPT
153 LBL 00
154 RCL 12
155 STO IND 11
156 1
157 -
158 5
159 MOD
160 X=0?
161 SF IND 11
162 ISG 11
163 GTO 61
164 RCL 07
165 RCL 08
166 X>Y?
167 X<>Y
168 RCL 09
169 X>Y?
170 X<>Y
171 10
172 /
173 X<> Z
174 X>Y?
175 X<>Y
176 1 E2
177 /
178 X<>Y
179 1 E3
180 /
181 +
182 +
183 STO IND 00
184 302
185 FS? 07
186 300
187 FS? 08
188 301
189 ST+ IND 00
190 ISG 00
191 GTO 60
192 24.035
193 STO 00
194 LBL 70
195 CF 05
196 CF 07
197 CF 08
198 RCL 00
199 INT
200 28
201 X=Y?
202 SF 05
203 "*****" ;5 asterisks
204 ARCL IND 00
205 ASTO L
206 ASHF
```

```
207 ASTO Y
208 "*"          ;1 asterisk
209 ARCL L
210 ASHF
211 ASTO X
212 FS? 05
213 X<>Y
214 STO 07
215 X<>Y
216 STO 08
217 7.008
218 STO 11
219 LBL 71
220 6
221 STO 12
222 LBL 72
223 RCL IND 12
224 RCL IND 11
225 X=Y?
226 GTO 00
227 DSE 12
228 GTO 72
229 "ERROR"
230 PROMPT
231 LBL 00
232 RCL 12
233 STO IND 11
234 1
235 -
236 5
237 MOD
238 X=0?
239 SF IND 11
240 ISG 11
241 GTO 71
242 RCL 07
243 RCL 08
244 X>Y?
245 X<>Y
246 10
247 /
248 X<>Y
249 1 E2
250 /
251 +
252 STO IND 00
253 1
254 FS? 08
255 ST+ IND 00
256 FC? 07
257 FS? 08
258 GTO 00
259 .25
260 RCL IND 00
261 CF 05
262 X=Y?
263 SF 05
264 RCL 08
265 RCL 07
266 FS? 05
267 X<>Y
268 X>Y?
269 SF 07
270 1
271 FC? 07
272 ST+ IND 00
273 LBL 00
274 ISG 00
275 GTO 70
276 ADV
```



```

277 ADV
278 "X"
279 ASTO 11
280 "Y"
281 ASTO 12
282 "Z"
283 ASTO 13
284 0
285 STO 10
286 STO 14
287 CLA
288 SREG 08      ;sigmaREG
289 12.015
290 STO 06
291 INT
292 STO 15
293 LBL 31
294 CLS          ;CLSigma
295 RCL 06
296 2
297 -
298 RCL IND X
299 SIGN
300 X=0?
301 XEQ IND L
302 RCL 06
303 INT
304 1 E2
305 /
306 STO 08
307 24.035
308 STO 07
309 LBL 32
310 RCL IND 07
311 FRC
312 RCL 08
313 X=Y?
314 GTO 00
315 ISG 07
316 GTO 32
317 LBL 00
318 RCL IND 07
319 INT
320 2
321 MOD
322 CF 05
323 X#0?
324 SF 05
325 RCL 07
326 INT
327 23
328 -
329 RCL X
330 4
331 MOD
332 X=0?
333 X<> L
334 5
335 X<>Y
336 -
337 X<>Y
338 RCL IND Y
339 3
340 /
341 -
342 FC? 05
343 -1
344 FS? 05
345 11
346 +

```

```

347 X#0?
348 XEQ IND X
349 ISG 06
350 GTO 31
351 GTO 40
352 LBL 01
353 8.1605
354 GTO "T" ;Calculate Next Move (X - Line 25)
355 LBL 02
356 11.1705
357 GTO "T" ;Calculate Next Move (X - Line 25)
358 LBL 03
359 14.1805
360 GTO "T" ;Calculate Next Move (X - Line 25)
361 LBL 04
362 3.1301
363 GTO "T" ;Calculate Next Move (X - Line 25)
364 LBL 05
365 4
366 GTO "T" ;Calculate Next Move (X - Line 25)
367 LBL 06
368 1.0703
369 GTO "T" ;Calculate Next Move (X - Line 25)
370 LBL 07
371 14.0614
372 GTO "T" ;Calculate Next Move (X - Line 25)
373 LBL 08
374 5
375 GTO "T" ;Calculate Next Move (X - Line 25)
376 LBL 09
377 16.05
378 GTO "T" ;Calculate Next Move (X - Line 25)
379 LBL 10
380 17.05
381 GTO "T" ;Calculate Next Move (X - Line 25)
382 LBL 11
383 18.05
384 GTO "T" ;Calculate Next Move (X - Line 25)
385 LBL 12
386 6.010903
387 GTO "T" ;Calculate Next Move (X - Line 25)
388 LBL 13
389 7.04
390 GTO "T" ;Calculate Next Move (X - Line 25)
391 LBL 14
392 12.031501
393 GTO "T" ;Calculate Next Move (X - Line 25)
394 LBL 15
395 15.06
396 GTO "T" ;Calculate Next Move (X - Line 25)
397 LBL 16
398 6
399 GTO "T" ;Calculate Next Move (X - Line 25)
400 LBL 17
401 1.0903
402 GTO "T" ;Calculate Next Move (X - Line 25)
403 LBL 18
404 2.1202
405 GTO "T" ;Calculate Next Move (X - Line 25)
406 LBL 19
407 3.1501
408 GTO "T" ;Calculate Next Move (X - Line 25)
409 LBL 20
410 6.031301
411 GTO "T" ;Calculate Next Move (X - Line 25)
412 LBL 21
413 9.0407
414 GTO "T" ;Calculate Next Move (X - Line 25)
415 LBL 22
416 18.130615

```

```

417 GTO "T"      ;Calculate Next Move (X - Line 25)
418 LBL 23
419 13.0615
420 GTO "T"      ;Calculate Next Move (X - Line 25)
421 LBL 40
422 2.005
423 STO 06
424 LBL 33
425 CLS          ;CLSigma
426 RCL 06
427 8
428 +
429 RCL IND X
430 SIGN
431 X=0?
432 XEQ IND L
433 .112
434 RCL 06
435 INT
436 1 E3
437 /
438 RCL 06
439 INT
440 1
441 -
442 1 E2
443 /
444 .1
445 +
446 +
447 X=Y?
448 .125
449 STO 08
450 16.023
451 STO 07
452 LBL 34
453 RCL IND 07
454 FRC
455 RCL 08
456 X=Y?
457 GTO 00
458 ISG 07
459 GTO 34
460 LBL 00
461 CF 05
462 CF 06
463 CF 07
464 CF 08
465 RCL 07
466 INT
467 19
468 X<Y?
469 SF 08
470 2
471 RCL IND 07
472 INT
473 3
474 MOD
475 X=0?
476 SF 05
477 1
478 FS? 08
479 X<> Z
480 X=Y?
481 SF 06
482 RDN
483 X=Y?
484 SF 07
485 RCL 07
486 INT

```

```

487 15
488 -
489 RCL X
490 4
491 MOD
492 X=0?
493 X<> L
494 5
495 X<>Y
496 -
497 X<>Y
498 RCL IND Y
499 3
500 /
501 -
502 FS? 05
503 -1
504 FS? 06
505 7
506 FS? 07
507 15
508 +
509 X#0?
510 XEQ IND X
511 ISG 06
512 GTO 33
513 RCL 15
514 12
515 STO 15
516 X#Y?
517 XEQ "S"      ;Display/Printer Subroutine (Line 615)
518 AVIEW
519 TONE 9
520 FC? 55
521 STOP
522 "LOAD STAGE 2"
523 BEEP
524 PROMPT      ;Ready to Load Program R2
525 STOP
526 LBL 01
527 15.0718
528 XEQ "T"      ;Calculate Next Move (X - Line 25)
529 9.1613
530 GTO "T"      ;Calculate Next Move (X - Line 25)
531 LBL 02
532 15.09170713
533 GTO "T"      ;Calculate Next Move (X - Line 25)
534 LBL 03
535 4.12161
536 XEQ "T"      ;Calculate Next Move (X - Line 25)
537 18.06
538 GTO "T"      ;Calculate Next Move (X - Line 25)
539 LBL 04
540 15.17131615
541 XEQ "T"      ;Calculate Next Move (X - Line 25)
542 18.13
543 GTO "T"      ;Calculate Next Move (X - Line 25)
544 LBL 05
545 15.17130416
546 XEQ "T"      ;Calculate Next Move (X - Line 25)
547 6
548 GTO "T"      ;Calculate Next Move (X - Line 25)
549 LBL 06
550 15.18130416
551 XEQ "T"      ;Calculate Next Move (X - Line 25)
552 6
553 GTO "T"      ;Calculate Next Move (X - Line 25)
554 LBL 07
555 4
556 XEQ "T"      ;Calculate Next Move (X - Line 25)

```

```

557 17.06151813
558 GTO "T"      ;Calculate Next Move (X - Line 25)
559 LBL 08
560 15.16130416
561 XEQ "T"      ;Calculate Next Move (X - Line 25)
562 6
563 GTO "T"      ;Calculate Next Move (X - Line 25)
564 LBL 09
565 15.07161309
566 GTO "T"      ;Calculate Next Move (X - Line 25)
567 LBL 10
568 15.10171213
569 GTO "T"      ;Calculate Next Move (X - Line 25)
570 LBL 11
571 12.161
572 XEQ "T"      ;Calculate Next Move (X - Line 25)
573 18.041606
574 GTO "T"      ;Calculate Next Move (X - Line 25)
575 LBL 12
576 4.1606
577 GTO "T"      ;Calculate Next Move (X - Line 25)
578 LBL 13
579 15.1613
580 GTO "T"      ;Calculate Next Move (X - Line 25)
581 LBL 14
582 15.1713
583 GTO "T"      ;Calculate Next Move (X - Line 25)
584 LBL 15
585 18.041606
586 GTO "T"      ;Calculate Next Move (X - Line 25)
587 LBL 16
588 4
589 XEQ "T"      ;Calculate Next Move (X - Line 25)
590 18.06151813
591 GTO "T"      ;Calculate Next Move (X - Line 25)
592 LBL 17
593 7.18
594 XEQ "T"      ;Calculate Next Move (X - Line 25)
595 9.16151813
596 GTO "T"      ;Calculate Next Move (X - Line 25)
597 LBL 18
598 4.09170706
599 GTO "T"      ;Calculate Next Move (X - Line 25)
600 LBL 19
601 4.1218061
602 GTO "T"      ;Calculate Next Move (X - Line 25)
603 LBL 20
604 15.1813
605 GTO "T"      ;Calculate Next Move (X - Line 25)
606 LBL 21
607 16.151813
608 GTO "T"      ;Calculate Next Move (X - Line 25)
609 LBL 22
610 17.151813
611 GTO "T"      ;Calculate Next Move (X - Line 25)
612 LBL 23
613 4.1806
614 GTO "T"      ;Calculate Next Move (X - Line 25)
615 LBL "S"      ;Display/Printer Subroutine
616 TONE 6
617 FS? 55
618 RTN
619 FS? 50
620 STOP
621 RTN
622 END

```

HP-41C Rubik's Cube Solver R by Julian Perry
PPC Calculator Journal Vol 9 N2 P24 Mar 1982
Includes changes by Gessler NOP PPC V10N4P3.

05EFC000F20052A915AC37A815A91CA91D9C008A8F1A121013
1212118F1A121810121219F1461A111612141117E000321A12
1113131212F14C1A12191013138F1A111712151118E000321A
121213141213F1421A1310101413118F1A111812161119E000
321A1213131512F1521A1311101512188F1A111912171116E0
00321A111612141117F1441A1217101112158F1A1119121611
18E000321A121313141212F1551A1315101613138F1A121013
121211E000328B11161A10121330D0003CCF32F67F20464143
459A003D753C753B11111A1011133FCF33908F37879B00F67F
20524F57202F1110419B73AC37A7418C9F068E9A09F33A2020
9B099A09879B09AC37A741AC37A74A1338CF34F12A9B099A09
8827111B124269377690F37A679B749AF29708D00034960FD0
003385CF44A905A907A9081116206878A805121044A805F42A
2A2A2A9B809A74889A72F12A9B749A74889A73F12A9B74889A
07AC0571387139171A1010193BCF3D163CCF3E908C908B78B1
00970CD0003EF54552524F528E012C918B1141154B67A88B96
0BD0003D27284571294571111043CE714571111B124371111B
134340409180131012AC07131010AC0813101192809600D000
3C12141A10131530CF46A905A907A9082068121878A805F52A
2A2A2A2A9B809A74889A72F12A9B74889A73AC057137713817
1A1010183BCF47163CCF48908C908B78B100970CD00048F545
52524F528E012C918B1141154B67A88B960BD0004727284571
11104371111B124340918011AC089280AD07AC08B1001A1215
9080A90578A8052827AC057145A80711AD079280019600D000
468F8FF1589A0BF1599A0CF15A9A0D103A3E87990811121A10
111536683FCF1F7026124190F37A67AEF42668111B12433812
141A10131537CF209087692878B1009607D000200190876812
4BA90563A80527681213419073144B67CE741571417190F213
4341AD051C11AC0511114063AEF39606D0001FD0002802181A
111610151DF1540311111A111710151DF1540411141A111810
151DF15405131A111310111DF15406141DF15407111A101710
131DF1540811141A101611141DF15409151DF1540A11161A10
151DF1540B11171A10151DF1540C11181A10151DF1540D161A
1011101910131DF1540E171A10141DF1540F11121A10131115
10111DF154CF0F11151A10161DF154CF10161DF154CF11111A
101910131DF154CF12121A111210121DF154CF13131A111510
111DF154CF14161A1013111310111DF154CF15191A10141017
1DF154CF1611181A1113101611151DF154CF1711131A101611
151DF154CF28121A10101536CF217026184090F37A67AEF41A
1111122668111B134326681141111B12431A114040781A1112
153811161A10121337CF229087692878B1009607D0002201A9
05A906A907A9082768111944A80812908768134B67A80511AC
08CE7178A8067578A80727681115419073144B67CE74157141
7190F2134341AC051C11AC0617AC0711154063AEF39606D000
212F11123F791EF1537E9F09AD3784FC4C4F41442053544147
452032868E840211151A101711181EF154191A111611131DF1
540311151A10191117101711131DF15404141A11121116111E
F15411181A10161DF1540511151A11171113111611151EF154
11181A11131DF1540611151A11171113101411161EF154161D
F1540711151A11181113101411161EF154161DF15408141EF1
5411171A10161115111811131DF1540911151A111611131014
11161EF154161DF1540A11151A10171116111310191DF1540B
11151A11101117111211131DF1540C11121A1116111EF15411
181A1014111610161DF1540D141A111610161DF1540E11151A
111611131DF1540F11151A111711131DF154CF0F11181A1014
111610161DF154CF10141EF15411181A10161115111811131D
F154CF11171A11181EF154191A11161115111811131DF154CF
12141A10191117101710161DF154CF13141A11121118101611
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131DF154CF1611171A1115111811131DF154CF17141A111810
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1519 BYTES

HP-41C Rubik's Cube Solver R2 by Julian Perry
PPC Calculator Journal V9 No 2 Pg 24 Mar 1982
Includes changes by Gessler NOP PPC V10 N4 P3

```
01 LBL "R2"      ;Rubik's Cube Solver - Part 2
02 CLA
03 2.005
04 STO 06
05 LBL 35
06 CLS          ;CLSigma
07 RCL 06
08 8
09 +
10 RCL IND X
11 SIGN
12 X=0?
13 XEQ IND L
14 12
15 RCL 06
16 INT
17 RCL X
18 1
19 -
20 10
21 *
22 +
23 X=Y?
24 25
25 STO 08
26 24.035
27 STO 07
28 LBL 36
29 RCL IND 07
30 FRC
31 E2
32 *
33 RCL 08
34 X=Y?
35 GTO 00
36 ISG 07
37 GTO 36
38 LBL 00
39 CF 01
40 RCL IND 07
41 INT
42 2
43 MOD
44 X#0?
45 SF 01
46 RCL 07
47 INT
48 27
49 -
50 RCL X
51 4
52 MOD
53 X=0?
54 X<> L
55 5
56 X<>Y
57 -
58 X<>Y
59 RCL IND Y
60 3
61 /
62 -
63 FC? 01
64 -1
65 FS? 01
66 7
```

```

67 +
68 X#0?
69 XEQ IND X
70 ISG 06
71 GTO 35
72 GTO 00
73 LBL 01
74 7.15181316
75 XEQ "T" ;Calculate Next Move (X - Line 25)
76 4.160609
77 GTO "T" ;Calculate Next Move (X - Line 25)
78 LBL 02
79 8.16030518
80 XEQ "T" ;Calculate Next Move (X - Line 25)
81 1
82 GTO "T" ;Calculate Next Move (X - Line 25)
83 LBL 03
84 12.0416
85 XEQ "T" ;Calculate Next Move (X - Line 25)
86 6.181518131
87 GTO "T" ;Calculate Next Move (X - Line 25)
88 LBL 04
89 4.170718
90 XEQ "T" ;Calculate Next Move (X - Line 25)
91 9.1706
92 GTO "T" ;Calculate Next Move (X - Line 25)
93 LBL 05
94 18.0416
95 XEQ "T" ;Calculate Next Move (X - Line 25)
96 6.18151813
97 GTO "T" ;Calculate Next Move (X - Line 25)
98 LBL 06
99 4.16
100 XEQ "T" ;Calculate Next Move (X - Line 25)
101 6.18151813
102 GTO "T" ;Calculate Next Move (X - Line 25)
103 LBL 07
104 10.14161318
105 XEQ "T" ;Calculate Next Move (X - Line 25)
106 14.12
107 GTO "T" ;Calculate Next Move (X - Line 25)
108 LBL 08
109 15.17131815
110 XEQ "T" ;Calculate Next Move (X - Line 25)
111 17.13180416
112 XEQ "T" ;Calculate Next Move (X - Line 25)
113 6
114 GTO "T" ;Calculate Next Move (X - Line 25)
115 LBL 09
116 5.17051705
117 GTO "T" ;Calculate Next Move (X - Line 25)
118 LBL 10
119 9.16090518
120 XEQ "T" ;Calculate Next Move (X - Line 25)
121 6.16050716
122 XEQ "T" ;Calculate Next Move (X - Line 25)
123 7
124 GTO "T" ;Calculate Next Move (X - Line 25)
125 LBL 11
126 14.17141714
127 GTO "T" ;Calculate Next Move (X - Line 25)
128 LBL 12
129 9.05180616
130 XEQ "T" ;Calculate Next Move (X - Line 25)
131 5.07
132 GTO "T" ;Calculate Next Move (X - Line 25)
133 LBL 13
134 15.181316
135 XEQ "T" ;Calculate Next Move (X - Line 25)
136 4.1606

```



```

137 GTO "T"      ;Calculate Next Move (X - Line 25)
138 LBL 14
139 16.15181316
140 XEQ "T"      ;Calculate Next Move (X - Line 25)
141 4.1606
142 GTO "T"      ;Calculate Next Move (X - Line 25)
143 LBL 15
144 15.1712161
145 XEQ "T"      ;Calculate Next Move (X - Line 25)
146 17.13
147 GTO "T"      ;Calculate Next Move (X - Line 25)
148 LBL 00
149 CLS          ;CLSigma
150 CF 01
151 CF 02
152 CF 03
153 CF 04
154 RCL 21
155 FRC
156 .256
157 X=Y?
158 SF 02
159 RCL 22
160 FRC
161 X<>Y
162 X=Y?
163 SF 03
164 RCL 23
165 FRC
166 X<>Y
167 X=Y?
168 SF 04
169 0
170 FS?C 02
171 16
172 FS?C 03
173 17
174 FS?C 04
175 18
176 X#0?
177 XEQ "T"      ;Calculate Next Move (X - Line 25)
178 RCL 21
179 FRC
180 .236
181 X=Y?
182 SF 01
183 RCL 22
184 FRC
185 .346
186 X=Y?
187 SF 02
188 RCL 23
189 FRC
190 .456
191 X=Y?
192 SF 03
193 0
194 INT
195 1
196 FC?C 01
197 ST+ L
198 2
199 FC?C 02
200 ST+ L
201 4
202 FC?C 03
203 ST+ L
204 GTO IND L
205 LBL 05
206 18.120918

```

```

207 XEQ "T"      ;Calculate Next Move (X - Line 25)
208 7.161
209 XEQ "T"      ;Calculate Next Move (X - Line 25)
210 GTO 00
211 LBL 03
212 XEQ "Z"      ;Initialize R01-R04 Z Axis (X - Line 17)
213 LBL 06
214 7.12091
215 XEQ "T"      ;Calculate Next Move (X - Line 25)
216 16.10181218
217 XEQ "T"      ;Calculate Next Move (X - Line 25)
218 GTO 00
219 LBL 07
220 RCL 21
221 FRC
222 .346
223 X=Y?
224 GTO 07
225 18.15160718
226 XEQ "T"      ;Calculate Next Move (X - Line 25)
227 13.1609
228 XEQ "T"      ;Calculate Next Move (X - Line 25)
229 GTO 00
230 LBL 07
231 7.181516
232 XEQ "T"      ;Calculate Next Move (X - Line 25)
233 9.181316
234 XEQ "T"      ;Calculate Next Move (X - Line 25)
235 LBL 00
236 CLS          ;CLSigma
237 RCL 20
238 INT
239 3
240 MOD
241 STO 06
242 X#0?
243 SF 01
244 RCL 21
245 INT
246 3
247 MOD
248 STO 07
249 X#0?
250 SF 02
251 RCL 22
252 INT
253 3
254 MOD
255 STO 08
256 X#0?
257 SF 03
258 RCL 23
259 INT
260 3
261 MOD
262 STO 09
263 X#0?
264 SF 04
265 FS? 01
266 XEQ IND 06
267 FC? 02
268 GTO 00
269 16
270 XEQ "T"      ;Calculate Next Move (X - Line 25)
271 XEQ IND 07
272 LBL 00
273 FC? 03
274 GTO 00
275 17
276 FS? 02

```

```

277 16
278 XEQ "T"      ;Calculate Next Move (X - Line 25)
279 XEQ IND 08
280 LBL 00
281 FC? 04
282 GTO 00
283 18
284 FS? 02
285 17
286 FS? 03
287 16
288 XEQ "T"      ;Calculate Next Move (X - Line 25)
289 XEQ IND 09
290 LBL 00
291 0
292 FS? 02
293 18
294 FS? 03
295 17
296 FS? 04
297 16
298 XEQ "T"      ;Calculate Next Move (X - Line 25)
299 GTO 00
300 LBL 01
301 3.060104
302 STO 06
303 XEQ "T"      ;Calculate Next Move (X - Line 25)
304 RCL 06
305 GTO "T"      ;Calculate Next Move (X - Line 25)
306 LBL 02
307 6.030401
308 STO 06
309 XEQ "T"      ;Calculate Next Move (X - Line 25)
310 RCL 06
311 GTO "T"      ;Calculate Next Move (X - Line 25)
312 LBL 00
313 SF 01
314 SF 02
315 SF 03
316 SF 04
317 RCL 32
318 INT
319 2
320 MOD
321 X=0?
322 CF 01
323 RCL 33
324 INT
325 2
326 MOD
327 X=0?
328 CF 02
329 RCL 34
330 INT
331 2
332 MOD
333 X=0?
334 CF 03
335 RCL 35
336 INT
337 2
338 MOD
339 X=0?
340 CF 04
341 0
342 INT
343 1
344 FS?C 01
345 ST+ L
346 2

```

```

347 FS?C 02
348 ST+ L
349 4
350 FS?C 03
351 ST+ L
352 8
353 FS?C 04
354 ST+ L
355 CLS ;CLSigma
356 GTO IND L
357 LBL 06
358 XEQ "X" ;Initialize R01-R04 X Axis (X - Line 1)
359 GTO 01
360 LBL 09
361 XEQ "Z" ;Initialize R01-R04 Z Axis (X - Line 17)
362 GTO 01
363 LBL 12
364 XEQ "Y" ;Initialize R01-R04 Y Axis (X - Line 9)
365 LBL 03
366 LBL 01
367 4.17061512
368 XEQ "T" ;Calculate Next Move (X - Line 25)
369 9.17071013
370 XEQ "T" ;Calculate Next Move (X - Line 25)
371 GTO 00
372 LBL 10
373 XEQ "Z" ;Initialize R01-R04 Z Axis (X - Line 17)
374 LBL 05
375 LBL 02
376 7.10131815
377 XEQ "T" ;Calculate Next Move (X - Line 25)
378 12.09061604
379 XEQ "T" ;Calculate Next Move (X - Line 25)
380 GTO 00
381 LBL 15
382 7.13040817
383 XEQ "T" ;Calculate Next Move (X - Line 25)
384 8.170817
385 XEQ "T" ;Calculate Next Move (X - Line 25)
386 6.1509
387 XEQ "T" ;Calculate Next Move (X - Line 25)
388 LBL 00
389 RCL 32
390 FRC
391 STO 06
392 .26
393 X=Y?
394 SF 01
395 RCL 33
396 FRC
397 STO 07
398 .36
399 X=Y?
400 SF 02
401 RCL 34
402 FRC
403 STO 08
404 .46
405 X=Y?
406 SF 03
407 RCL 35
408 FRC
409 STO 09
410 .56
411 X=Y?
412 SF 04
413 0
414 INT
415 1
416 FC?C 01

```

```

417 ST+ L
418 2
419 FC?C 02
420 ST+ L
421 4
422 FC?C 03
423 ST+ L
424 8
425 FC?C 04
426 ST+ L
427 CLS ;CLSigma
428 LASTX
429 X#0?
430 XEQ IND L
431 RCL 15
432 12
433 X#Y?
434 XEQ "S" ;Display/Printer Subroutine (Line 505)
435 AVIEW
436 TONE 9
437 FC? 55
438 STOP
439 ADV
440 " " ;1 space
441 FIX 0
442 CF 29
443 ARCL 14
444 ">" MOVES"
445 BEEP
446 AVIEW
447 STOP
448 LBL 07
449 XEQ "Y" ;Initialize R01-R04 Y Axis (X - Line 9)
450 .26
451 RCL 07
452 X=Y?
453 GTO 02
454 GTO 01
455 LBL 11
456 XEQ "X" ;Initialize R01-R04 X Axis (X - Line 1)
457 .26
458 RCL 07
459 X=Y?
460 GTO 02
461 GTO 01
462 LBL 13
463 .26
464 RCL 08
465 X=Y?
466 GTO 02
467 GTO 01
468 LBL 14
469 XEQ "Z" ;Initialize R01-R04 Z Axis (X - Line 17)
470 .56
471 RCL 07
472 X=Y?
473 GTO 02
474 LBL 01
475 14.18061014
476 XEQ "T" ;Calculate Next Move (X - Line 25)
477 12.041814
478 GTO "T" ;Calculate Next Move (X - Line 25)
479 LBL 02
480 14.16061014
481 XEQ "T" ;Calculate Next Move (X - Line 25)
482 12.041614
483 GTO "T" ;Calculate Next Move (X - Line 25)
484 LBL 15
485 RCL 08
486 .26

```

```
487 X=Y?
488 GTO 03
489 RCL 07
490 X=Y?
491 XEQ "X"      ;Initialize R01-R04 X Axis (X - Line 1)
492 8.14160511
493 XEQ "T"      ;Calculate Next Move (X - Line 25)
494 14.05110818
495 XEQ "T"      ;Calculate Next Move (X - Line 25)
496 8.14
497 GTO "T"      ;Calculate Next Move (X - Line 25)
498 LBL 03
499 8.14030814
500 XEQ "T"      ;Calculate Next Move (X - Line 25)
501 17.081403
502 XEQ "T"      ;Calculate Next Move (X - Line 25)
503 8.14
504 GTO "T"      ;Calculate Next Move (X - Line 25)
505 LBL "S"      ;Display/Printer Subroutine
506 TONE 6
507 FS? 55
508 RTN
509 FS? 50
510 STOP
511 RTN
512 END
```

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CF249087691B12422878B1009607D0002401A901908768124B
63A80127681217419073144B67CE741571417190F2134341AD
011C11AC01174063AEF39606D00023B10002171A1115111811
1311161EF154141A1116101610191DF15403181A1116101310
1511181EF154111DF1540411121A101411161EF154161A1118
111511181113111DF15405141A1117101711181EF154191A11
1710161DF1540611181A101411161EF154161A111811151118
11131DF15407141A11161EF154161A11181115111811131DF1
540811101A11141116111311181EF15411141A11121DF15409
11151A11171113111811151EF15411171A1113111810141116
1EF154161DF1540A151A11171015111710151DF1540B191A11
161019101511181EF154161A11161015101711161EF154171D
F1540C11141A11171114111711141DF1540D191A1015111810
1611161EF154151A10171DF1540E11151A1118111311161EF1
54141A111610161DF1540F11161A11151118111311161EF154
141A111610161DF154CF0F11151A111711121116111EF15411
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1EF154B100041EF15A07171A11121019111EF15411161A1110
1118111211181EF154B100089015691A13141678B80011181A
11151116101711181EF15411131A111610191EF154B1000817
1A1118111511161EF154191A1118111311161EF15401709014
68134B3663A801901568134B3763A802901668134B3863A803
901768134B3963A804AC01AE86AD02B10011161EF154AE8701
AD03B1001117AC0211161EF154AE8801AD04B1001118AC0211
17AC0311161EF154AE890110AC021118AC031117AC0411161E
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0B1EF15A0603171A11101113111811151EF15411121A101910
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162878B300B2000F1EF15A1A15162778B3000211141A111810
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1293 BYTES

HP-41C Rubik's Cube Solver X by Julian Perry PPC V10 N4 P3 May 1983

Program Registers Needed: 64

Row 1 (1 - 8)



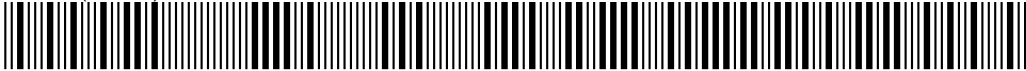
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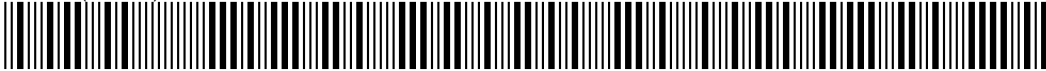
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Row 4 (25 - 33)



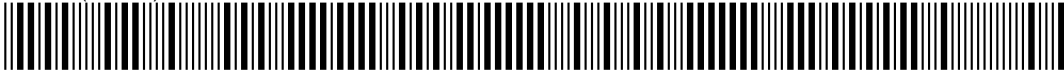
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Row 6 (44 - 52)



Row 7 (52 - 60)



Row 8 (61 - 66)



Row 9 (67 - 74)



Row 10 (74 - 80)



Row 11 (81 - 87)



Row 12 (88 - 95)



Row 13 (95 - 102)



Row 14 (103 - 109)



Row 15 (110 - 116)



Row 16 (117 - 123)



HP-41C Rubik's Cube Solver X by Julian Perry PPC V10 N4 P3 May 1983

Row 17 (124 - 129)



Row 18 (130 - 137)



Row 19 (138 - 144)



Row 20 (145 - 151)



Row 21 (152 - 158)



Row 22 (158 - 163)



Row 23 (164 - 171)



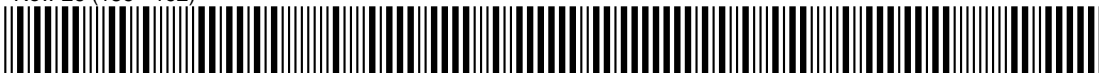
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Row 25 (179 - 185)



Row 26 (186 - 192)



Row 27 (192 - 197)



Row 28 (198 - 205)



Row 29 (206 - 212)



Row 30 (213 - 219)



Row 31 (220 - 226)



Row 32 (226 - 231)



Row 33 (232 - 239)



HP-41C Rubik's Cube Solver X by Julian Perry PPC V10 N4 P3 May 1983

Row 34 (239 - 246)



Row 35 (246 - 247)



HP-41C Rubik's Cube Solver R by Julian Perry PPC V10 N4 P3 May 1983

Program Registers Needed: 217

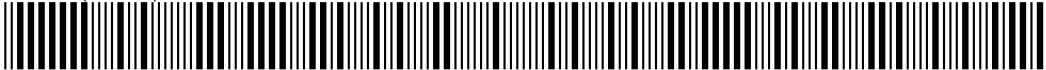
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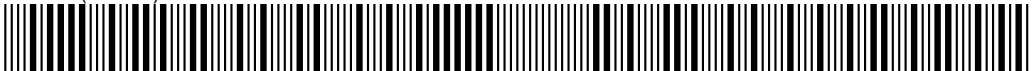
Row 2 (6 - 10)



Row 3 (11 - 14)



Row 4 (14 - 16)



Row 5 (16 - 20)



Row 6 (20 - 22)



Row 7 (22 - 26)



Row 8 (26 - 28)



Row 9 (28 - 32)



Row 10 (32 - 34)



Row 11 (34 - 38)



Row 12 (38 - 40)



Row 13 (40 - 43)



Row 14 (44 - 47)



Row 15 (47 - 51)



Row 16 (51 - 58)



HP-41C Rubik's Cube Solver R by Julian Perry PPC V10 N4 P3 May 1983

Row 17 (58 - 64)



Row 18 (65 - 69)



Row 19 (70 - 76)



Row 20 (76 - 83)



Row 21 (83 - 90)



Row 22 (91 - 100)



Row 23 (101 - 106)



Row 24 (106 - 113)



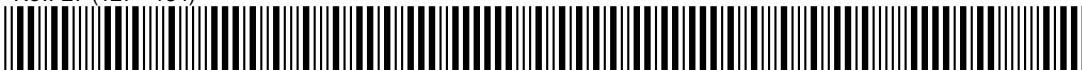
Row 25 (114 - 120)



Row 26 (120 - 127)



Row 27 (127 - 134)



Row 28 (135 - 142)



Row 29 (143 - 150)



Row 30 (150 - 155)



Row 31 (156 - 164)



Row 32 (165 - 175)



Row 33 (176 - 183)



HP-41C Rubik's Cube Solver R by Julian Perry PPC V10 N4 P3 May 1983

Row 34 (184 - 188)



Row 35 (189 - 192)



Row 36 (193 - 200)



Row 37 (201 - 205)



Row 38 (206 - 213)



Row 39 (214 - 221)



Row 40 (222 - 228)



Row 41 (228 - 234)



Row 42 (235 - 243)



Row 43 (244 - 252)



Row 44 (253 - 259)



Row 45 (259 - 267)



Row 46 (268 - 275)



Row 47 (275 - 282)



Row 48 (283 - 289)



Row 49 (289 - 299)



Row 50 (300 - 307)



HP-41C Rubik's Cube Solver R by Julian Perry PPC V10 N4 P3 May 1983

Row 51 (307 - 314)



Row 52 (315 - 322)



Row 53 (323 - 332)



Row 54 (333 - 342)



Row 55 (343 - 350)



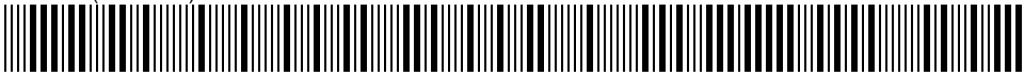
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Row 57 (354 - 357)



Row 58 (358 - 362)



Row 59 (362 - 366)



Row 60 (367 - 371)



Row 61 (371 - 375)



Row 62 (376 - 380)



Row 63 (380 - 384)



Row 64 (384 - 387)



Row 65 (388 - 392)



Row 66 (392 - 395)



Row 67 (395 - 400)



HP-41C Rubik's Cube Solver R by Julian Perry PPC V10 N4 P3 May 1983

Row 68 (401 - 404)



Row 69 (404 - 407)



Row 70 (407 - 410)



Row 71 (410 - 413)



Row 72 (414 - 416)



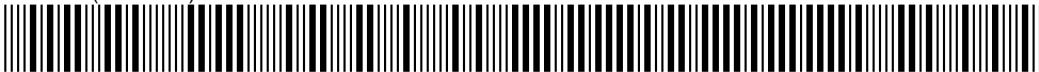
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Row 74 (420 - 424)



Row 75 (425 - 433)



Row 76 (433 - 442)



Row 77 (442 - 450)



Row 78 (450 - 456)



Row 79 (457 - 463)



Row 80 (463 - 471)



Row 81 (472 - 481)



Row 82 (481 - 490)



Row 83 (491 - 501)

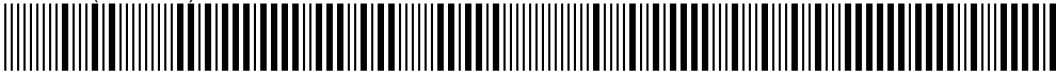


Row 84 (502 - 509)



HP-41C Rubik's Cube Solver R by Julian Perry PPC V10 N4 P3 May 1983

Row 85 (510 - 517)



Row 86 (517 - 522)



Row 87 (522 - 527)



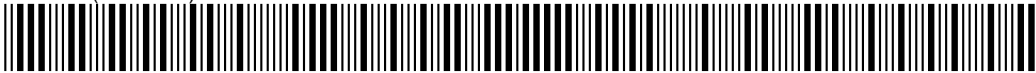
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Row 89 (529 - 532)



Row 90 (532 - 535)



Row 91 (535 - 538)



Row 92 (539 - 541)



Row 93 (541 - 545)



Row 94 (545 - 547)



Row 95 (548 - 550)



Row 96 (550 - 556)



Row 97 (556 - 558)



Row 98 (558 - 560)



Row 99 (560 - 565)



Row 100 (565 - 568)



Row 101 (568 - 570)



HP-41C Rubik's Cube Solver R by Julian Perry PPC V10 N4 P3 May 1983

Row 102 (571 - 573)



Row 103 (573 - 576)



Row 104 (576 - 579)



Row 105 (580 - 583)



Row 106 (583 - 586)



Row 107 (586 - 590)



Row 108 (590 - 593)



Row 109 (593 - 595)



Row 110 (595 - 598)



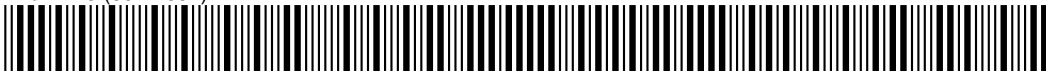
Row 111 (598 - 601)



Row 112 (601 - 604)



Row 113 (604 - 607)



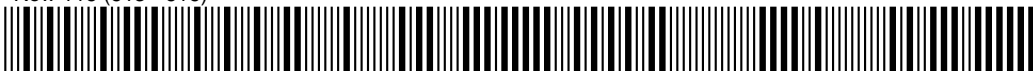
Row 114 (607 - 610)



Row 115 (610 - 613)



Row 116 (613 - 616)



Row 117 (616 - 622)



HP-41C Rubik's Cube Solver R2 by Julian Perry PPC V10 N4 P3 May 1983

Program Registers Needed: 185

Row 1 (1 - 4)



Row 2 (5 - 14)



Row 3 (14 - 24)



Row 4 (24 - 29)



Row 5 (30 - 37)



Row 6 (38 - 47)



Row 7 (48 - 57)



Row 8 (58 - 66)



Row 9 (67 - 74)



Row 10 (74 - 76)



Row 11 (76 - 79)



Row 12 (79 - 82)



Row 13 (82 - 85)



Row 14 (86 - 87)



Row 15 (87 - 90)



Row 16 (91 - 94)



HP-41C Rubik's Cube Solver R2 by Julian Perry PPC V10 N4 P3 May 1983

Row 17 (94 - 96)



Row 18 (96 - 100)



Row 19 (100 - 102)



Row 20 (102 - 104)



Row 21 (104 - 108)



Row 22 (109 - 110)



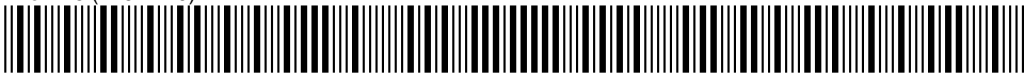
Row 23 (110 - 112)



Row 24 (112 - 116)



Row 25 (116 - 119)



Row 26 (119 - 121)



Row 27 (121 - 125)



Row 28 (126 - 127)



Row 29 (127 - 130)



Row 30 (130 - 134)



Row 31 (134 - 136)



Row 32 (136 - 139)



Row 33 (139 - 141)



HP-41C Rubik's Cube Solver R2 by Julian Perry PPC V10 N4 P3 May 1983

Row 34 (142 - 144)



Row 35 (144 - 147)



Row 36 (148 - 155)



Row 37 (156 - 163)



Row 38 (163 - 171)



Row 39 (172 - 178)



Row 40 (178 - 185)



Row 41 (185 - 190)



Row 42 (191 - 199)



Row 43 (200 - 206)



Row 44 (206 - 208)



Row 45 (208 - 214)



Row 46 (214 - 216)



Row 47 (216 - 220)



Row 48 (220 - 225)



Row 49 (225 - 227)



Row 50 (227 - 231)



HP-41C Rubik's Cube Solver R2 by Julian Perry PPC V10 N4 P3 May 1983

Row 51 (231 - 233)



Row 52 (233 - 240)



Row 53 (241 - 250)



Row 54 (251 - 260)



Row 55 (261 - 268)



Row 56 (269 - 275)



Row 57 (275 - 281)



Row 58 (282 - 288)



Row 59 (288 - 295)



Row 60 (295 - 301)



Row 61 (301 - 305)



Row 62 (305 - 309)



Row 63 (309 - 316)



Row 64 (316 - 325)



Row 65 (326 - 335)



Row 66 (335 - 345)



Row 67 (345 - 353)

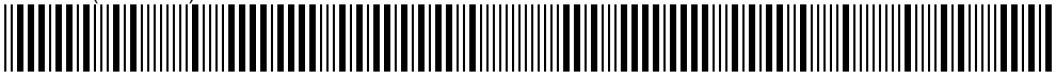


HP-41C Rubik's Cube Solver R2 by Julian Perry PPC V10 N4 P3 May 1983

Row 68 (353 - 360)



Row 69 (361 - 367)



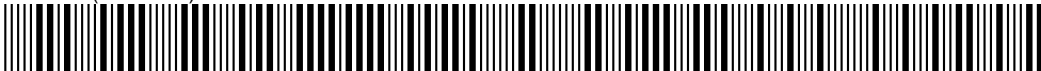
Row 70 (367 - 369)



Row 71 (369 - 371)



Row 72 (372 - 376)



Row 73 (376 - 378)



Row 74 (378 - 382)



Row 75 (382 - 384)



Row 76 (384 - 386)



Row 77 (386 - 392)



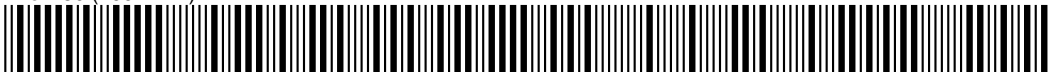
Row 78 (393 - 400)



Row 79 (401 - 408)



Row 80 (409 - 417)



Row 81 (417 - 425)



Row 82 (425 - 434)



Row 83 (434 - 441)



Row 84 (442 - 445)



HP-41C Rubik's Cube Solver R2 by Julian Perry PPC V10 N4 P3 May 1983

Row 85 (446 - 453)



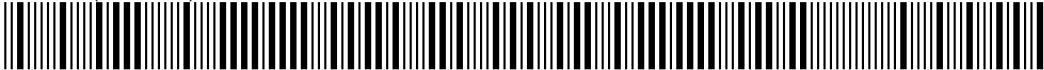
Row 86 (454 - 460)



Row 87 (461 - 468)



Row 88 (469 - 475)



Row 89 (475 - 477)



Row 90 (477 - 480)



Row 91 (480 - 481)



Row 92 (482 - 484)



Row 93 (484 - 491)



Row 94 (492 - 493)



Row 95 (494 - 495)



Row 96 (495 - 499)



Row 97 (499 - 501)



Row 98 (501 - 504)



Row 99 (504 - 509)



Row 100 (509 - 512)

