

T1、在0到200内找方程的整数解

1. 题目简介

在0到200之间找到方程的 $a^5 + b^5 + c^5 + d^5 = e^5$ 的整数解。

2. 程序描述

首先计算计算0-200的整数的五次方，将其存储在一个201维的数组result中，后面计算某个整数的5次方只需直接读取即可。

随后假设 $e \geq a \geq b \geq c \geq d$ 以减少遍历所需次数，去掉重复解。

同时，若 $e^5 < a^5 + b^5$ 便停止增加 b ，同理，若 $e^5 < a^5 + b^5 + c^5$ 便停止增大 c ，注意，对 d 不能这样，因为此时每次循环增加一次比较所消耗的时间明显大于节省遍历所节省的时间。

只要在遍历过程中得到 $a^5 + b^5 + c^5 + d^5 = e^5$ 的解，就会将其输出出来。

3. 伪代码

3.1 Algorithm 1 SolveEquation

input: None

output: a,b,c,d,e : (int)

result = range(201)**5

existence = false

for e \leftarrow 1 to 200 do

 for a \leftarrow 1 to e do

 for b \leftarrow 1 to a do

 if result[a]+result[b] < result[e] then

 for c \leftarrow 1 to b do

 if result[a]+result[b]+result[c] < result[e] then

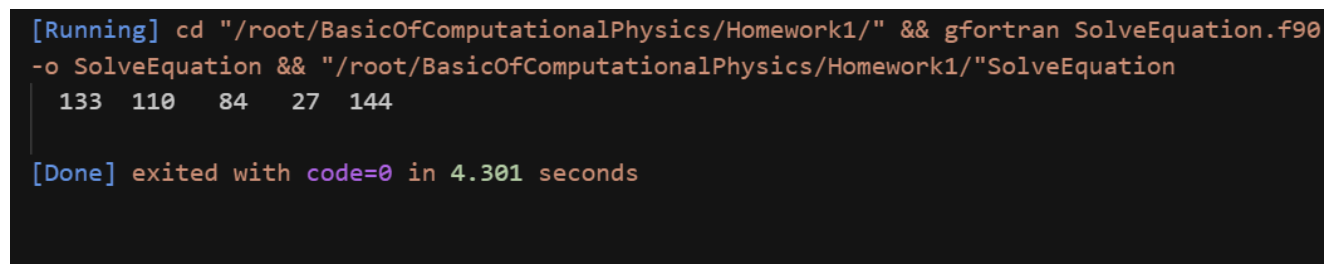
 for d \leftarrow 1 to c do

 if result[a]+result[b]+result[c]+result[d] == result[e]

 existence = true

```
        return a,b,c,d,e
    end if
end for
end if
end for
end if
end for
if not existence
return none
```

4. 运行效果



```
[Running] cd "/root/BasicOfComputationalPhysics/Homework1/" && gfortran SolveEquation.f90
-o SolveEquation && "/root/BasicOfComputationalPhysics/Homework1/"SolveEquation
133 110 84 27 144
[Done] exited with code=0 in 4.301 seconds
```

Figure 1

T2 24点

1. 题目简介

从一副扑克中抽取4张牌，对4张牌使用加减乘除中的任何方法，使计算结果为24。例如，2,3,4,6通过 $((4+6)-2)*3=24$ ，用程序找到算出24点的方法。

2. 程序描述

四个数字排序有 $4! = 24$ 种情况；

有三个运算符号，对应加减乘除4种运算有 $4^3 = 64$ 种情况；

不同的运算顺序（打括号的方法）有 $((AB)C)D$ 、 $(A(BC))D$ 、 $(AB)(CD)$ 、 $A((BC)D)$ 、 $A(B(CD))$ 共五种运算，因此总共有 $24 \times 64 \times 5 = 7680$ 种情况，只需找出其中等于24的情况即可。

在程序实现中，我们利用算法2计算出对4个数字的所有排列方式，再用算法3计算出对一种排列方式的所有计算方式可能得到的结果。最终只需要将二者结合起来即可得到计算24点的方式。

在算法3中，我们用1到4的数字分别对应加减乘除四种运算方式，

3. 伪代码

3.1 Algorithm 2 GetAllPermutations

input: a,b,c,d -» int

out: AllPermutations: matrix (int,shape=(24,3))

nums = [a,b,c,d]

count =1

for num1 \leftarrow a,b,c,d do

 for num2 \leftarrow a,b,c,d do

 if num1 \neq num2 then

 for num3 \leftarrow a,b,c,d do

 ...

 if num4 \neq num1 and num4 \neq num2 and num4 \neq num3

```

        AllPermutations[count,]  $\leftarrow$  [num1,num2,num3,num4]

        count +=1
    end if
end for
end if
end for
end for
return AllPermutations

```

3.2 Algorithm 3 GetAllResults

input: Permutation: Array (int,len=4)

output : AllResults: matrix(int,shape=(64,5))

A,B,C,D = Permutation

function Operator(OperatorNum->int,a->int,b->int):

if OperatorNum == 1 then

 result \leftarrow a+b

end if

if OperatorNum == 2 then

 result \leftarrow a-b

end if

if OperatorNum == 3 then

 result \leftarrow a*b

end if

if OperatorNum == 4 then

 result \leftarrow a/b

end if

return result

end function Operator

function ParenthesesPosition(Operatornums-
>Array(int,len=3),ParenthesesPositionNum->int, Permutation->):

if ParenthesesPositionNum==1 then

 result \leftarrow (A Operator1 B)Operator2 C)Operator3 D

end if

if ParenthesesPositionNum==2 then

 result \leftarrow (A Operator1 (B Operator2 C)Operator3 D

end if

if ParenthesesPositionNum==3 then

 result \leftarrow (A Operator1 B)Operator2 (C Operator3 D)

end if

if ParenthesesPositionNum==4 then

 result \leftarrow A Operator1 ((B Operator2 C) Operator3 D)

end if

if ParenthesesPositionNum==5 then

 result \leftarrow A Operator1 (B Operator2 (C Operator3 D)

end if

return result

end function ParenthesesPosition

count = 1

for i \leftarrow 1 to 4 do

 for j \leftarrow 1 to 4 do

 for k \leftarrow 1 to 4 do

 for l \leftarrow 1 to 4 do

 OperatorArray[count,:]= [i,j,k,l]

 count += 1

 end for

end for

end for

end for

AllResults[i,j] = ParenthesesPosition(OperatorArray[i,:],j)

return AllResults

4. 运行效果

```
1 [Running] cd "/root/BasicOfComputationalPhysics/Homework1/" &&
   gfortran Point24.f90 -o Point24 &&
   "/root/BasicOfComputationalPhysics/Homework1/"Point24
2 The parenthesis position is((AB)C)D
3 The selection of numbers and operation symbols is 4+ 6- 2* 3=24
4 The parenthesis position is(A(BC))D
5 The selection of numbers and operation symbols is 4+ 6- 2* 3=24
6 The parenthesis position isA((BC)D)
7 The selection of numbers and operation symbols is 4* 6/ 2+ 3=24
8 The parenthesis position is(A(BC))D
9 The selection of numbers and operation symbols is 4+ 6* 3+ 2=24
10 The parenthesis position isA((BC)D)
11 The selection of numbers and operation symbols is 4+ 6* 3+ 2=24
12 The parenthesis position is(A(BC))D
13 The selection of numbers and operation symbols is 4* 6- 3* 2=24
14 The parenthesis position isA((BC)D)
15 The selection of numbers and operation symbols is 4* 6- 3* 2=24
16 The parenthesis position isA(B(CD))
17 The selection of numbers and operation symbols is 4* 6* 3- 2=24
18 The parenthesis position isA(B(CD))
19 The selection of numbers and operation symbols is 4* 6/ 3- 2=24
20 The parenthesis position isA(B(CD))
21 The selection of numbers and operation symbols is 4+ 2+ 6* 3=24
22 The parenthesis position is((AB)C)D
23 The selection of numbers and operation symbols is 4- 2+ 6* 3=24
24 The parenthesis position is(A(BC))D
25 The selection of numbers and operation symbols is 4- 2- 6* 3=24
26 The parenthesis position isA(B(CD))
27 The selection of numbers and operation symbols is 4* 2* 6- 3=24
28 The parenthesis position is((AB)C)D
29 The selection of numbers and operation symbols is 4/ 2+ 6* 3=24
30 The parenthesis position isA(B(CD))
31 The selection of numbers and operation symbols is 4+ 2+ 3* 6=24
32 The parenthesis position is((AB)C)D
33 The selection of numbers and operation symbols is 4+ 2* 3+ 6=24
34 The parenthesis position is(A(BC))D
35 The selection of numbers and operation symbols is 4+ 3* 6+ 2=24
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36 The parenthesis position is $A((BC)D)$
37 The selection of numbers and operation symbols is $4+3*6+2=24$
38 The parenthesis position is $A(B(CD))$
39 The selection of numbers and operation symbols is $4*3+6/2=24$
40 The parenthesis position is $(A(BC))D$
41 The selection of numbers and operation symbols is $4*3-2*6=24$
42 The parenthesis position is $A((BC)D)$
43 The selection of numbers and operation symbols is $4*3-2*6=24$
44 The parenthesis position is $(A(BC))D$
45 The selection of numbers and operation symbols is $4/3-2*6=24$
46 The parenthesis position is $A((BC)D)$
47 The selection of numbers and operation symbols is $4/3-2/6=24$
48 The parenthesis position is $A((BC)D)$
49 The selection of numbers and operation symbols is $6+4+2*3=24$
50 The parenthesis position is $((AB)C)D$
51 The selection of numbers and operation symbols is $6+4-2*3=24$
52 The parenthesis position is $(A(BC))D$
53 The selection of numbers and operation symbols is $6+4-2*3=24$
54 The parenthesis position is $(A(BC))D$
55 The selection of numbers and operation symbols is $6+4/2*3=24$
56 The parenthesis position is $A(B(CD))$
57 The selection of numbers and operation symbols is $6*4*3-2=24$
58 The parenthesis position is $A(B(CD))$
59 The selection of numbers and operation symbols is $6*4/3-2=24$
60 The parenthesis position is $A((BC)D)$
61 The selection of numbers and operation symbols is $6+2+4*3=24$
62 The parenthesis position is $((AB)C)D$
63 The selection of numbers and operation symbols is $6-2+4*3=24$
64 The parenthesis position is $(A(BC))D$
65 The selection of numbers and operation symbols is $6-2-4*3=24$
66 The parenthesis position is $((AB)C)D$
67 The selection of numbers and operation symbols is $6*2-4*3=24$
68 The parenthesis position is $((AB)C)D$
69 The selection of numbers and operation symbols is $6/2+3*4=24$
70 The parenthesis position is $A(B(CD))$
71 The selection of numbers and operation symbols is $6+3*4+2=24$
72 The parenthesis position is $(AB)(CD)$
73 The selection of numbers and operation symbols is $6-3+4*2=24$
74 The parenthesis position is $(AB)(CD)$
75 The selection of numbers and operation symbols is $6-3-4*2=24$
76 The parenthesis position is $((AB)C)D$
77 The selection of numbers and operation symbols is $6-3*4*2=24$
78 The parenthesis position is $(AB)(CD)$
79 The selection of numbers and operation symbols is $6-3*4*2=24$
80 The parenthesis position is $(AB)(CD)$
81 The selection of numbers and operation symbols is $6-3/4*2=24$
82 The parenthesis position is $((AB)C)D$
83 The selection of numbers and operation symbols is $6*3+4+2=24$
84 The parenthesis position is $(AB)(CD)$
85 The selection of numbers and operation symbols is $6*3+4+2=24$

86 The parenthesis position is (AB) (CD)
87 The selection of numbers and operation symbols is $6 * 3 - 4 + 2 = 24$
88 The parenthesis position is (AB) (CD)
89 The selection of numbers and operation symbols is $6 * 3 * 4 + 2 = 24$
90 The parenthesis position is (AB) (CD)
91 The selection of numbers and operation symbols is $6 * 3 / 4 + 2 = 24$
92 The parenthesis position is A(B(CD))
93 The selection of numbers and operation symbols is $6 + 3 * 2 + 4 = 24$
94 The parenthesis position is (AB) (CD)
95 The selection of numbers and operation symbols is $6 - 3 + 2 * 4 = 24$
96 The parenthesis position is (AB) (CD)
97 The selection of numbers and operation symbols is $6 - 3 - 2 * 4 = 24$
98 The parenthesis position is ((AB)C)D
99 The selection of numbers and operation symbols is $6 - 3 * 2 * 4 = 24$
100 The parenthesis position is (AB) (CD)
101 The selection of numbers and operation symbols is $6 - 3 * 2 * 4 = 24$
102 The parenthesis position is (AB) (CD)
103 The selection of numbers and operation symbols is $6 - 3 / 2 * 4 = 24$
104 The parenthesis position is ((AB)C)D
105 The selection of numbers and operation symbols is $6 * 3 + 2 + 4 = 24$
106 The parenthesis position is (AB) (CD)
107 The selection of numbers and operation symbols is $6 * 3 + 2 + 4 = 24$
108 The parenthesis position is (AB) (CD)
109 The selection of numbers and operation symbols is $6 * 3 - 2 + 4 = 24$
110 The parenthesis position is (A(BC))D
111 The selection of numbers and operation symbols is $6 * 3 - 2 * 4 = 24$
112 The parenthesis position is A((BC)D)
113 The selection of numbers and operation symbols is $6 * 3 - 2 * 4 = 24$
114 The parenthesis position is (AB) (CD)
115 The selection of numbers and operation symbols is $6 * 3 * 2 + 4 = 24$
116 The parenthesis position is (AB) (CD)
117 The selection of numbers and operation symbols is $6 * 3 / 2 + 4 = 24$
118 The parenthesis position is (A(BC))D
119 The selection of numbers and operation symbols is $6 / 3 - 2 * 4 = 24$
120 The parenthesis position is A((BC)D)
121 The selection of numbers and operation symbols is $6 / 3 - 2 / 4 = 24$
122 The parenthesis position is A(B(CD))
123 The selection of numbers and operation symbols is $2 + 4 + 6 * 3 = 24$
124 The parenthesis position is A(B(CD))
125 The selection of numbers and operation symbols is $2 * 4 * 6 - 3 = 24$
126 The parenthesis position is A(B(CD))
127 The selection of numbers and operation symbols is $2 + 4 + 3 * 6 = 24$
128 The parenthesis position is ((AB)C)D
129 The selection of numbers and operation symbols is $2 + 4 * 3 + 6 = 24$
130 The parenthesis position is ((AB)C)D
131 The selection of numbers and operation symbols is $2 * 6 - 4 * 3 = 24$
132 The parenthesis position is (A(BC))D
133 The selection of numbers and operation symbols is $2 + 6 * 3 + 4 = 24$
134 The parenthesis position is A((BC)D)
135 The selection of numbers and operation symbols is $2 + 6 * 3 + 4 = 24$

136 The parenthesis position is $(A(BC))D$
137 The selection of numbers and operation symbols is $2 * 6 - 3 * 4 = 24$
138 The parenthesis position is $A((BC)D)$
139 The selection of numbers and operation symbols is $2 * 6 - 3 * 4 = 24$
140 The parenthesis position is $(A(BC))D$
141 The selection of numbers and operation symbols is $2 + 3 * 6 + 4 = 24$
142 The parenthesis position is $A((BC)D)$
143 The selection of numbers and operation symbols is $2 + 3 * 6 + 4 = 24$
144 The parenthesis position is $A((BC)D)$
145 The selection of numbers and operation symbols is $3 * 4 + 6 - 2 = 24$
146 The parenthesis position is $A(B(CD))$
147 The selection of numbers and operation symbols is $3 * 4 + 6 - 2 = 24$
148 The parenthesis position is $(A(BC))D$
149 The selection of numbers and operation symbols is $3 * 4 + 2 + 6 = 24$
150 The parenthesis position is $A((BC)D)$
151 The selection of numbers and operation symbols is $3 * 4 - 2 + 6 = 24$
152 The parenthesis position is $A(B(CD))$
153 The selection of numbers and operation symbols is $3 * 4 - 2 - 6 = 24$
154 The parenthesis position is $A((BC)D)$
155 The selection of numbers and operation symbols is $3 * 4 / 2 + 6 = 24$
156 The parenthesis position is $((AB)C)D$
157 The selection of numbers and operation symbols is $3 * 6 + 4 + 2 = 24$
158 The parenthesis position is $(AB)(CD)$
159 The selection of numbers and operation symbols is $3 * 6 + 4 + 2 = 24$
160 The parenthesis position is $A((BC)D)$
161 The selection of numbers and operation symbols is $3 * 6 + 4 - 2 = 24$
162 The parenthesis position is $A(B(CD))$
163 The selection of numbers and operation symbols is $3 * 6 + 4 - 2 = 24$
164 The parenthesis position is $A(B(CD))$
165 The selection of numbers and operation symbols is $3 * 6 + 4 / 2 = 24$
166 The parenthesis position is $(AB)(CD)$
167 The selection of numbers and operation symbols is $3 * 6 - 4 + 2 = 24$
168 The parenthesis position is $(AB)(CD)$
169 The selection of numbers and operation symbols is $3 * 6 * 4 + 2 = 24$
170 The parenthesis position is $(AB)(CD)$
171 The selection of numbers and operation symbols is $3 * 6 / 4 + 2 = 24$
172 The parenthesis position is $(A(BC))D$
173 The selection of numbers and operation symbols is $3 + 6 / 2 * 4 = 24$
174 The parenthesis position is $((AB)C)D$
175 The selection of numbers and operation symbols is $3 * 6 + 2 + 4 = 24$
176 The parenthesis position is $(AB)(CD)$
177 The selection of numbers and operation symbols is $3 * 6 + 2 + 4 = 24$
178 The parenthesis position is $(AB)(CD)$
179 The selection of numbers and operation symbols is $3 * 6 - 2 + 4 = 24$
180 The parenthesis position is $A((BC)D)$
181 The selection of numbers and operation symbols is $3 * 6 - 2 + 4 = 24$
182 The parenthesis position is $A(B(CD))$
183 The selection of numbers and operation symbols is $3 * 6 - 2 - 4 = 24$
184 The parenthesis position is $(AB)(CD)$
185 The selection of numbers and operation symbols is $3 * 6 * 2 + 4 = 24$

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186 The parenthesis position isA((BC)D)
187 The selection of numbers and operation symbols is 3* 6* 2- 4=24
188 The parenthesis position is(AB) (CD)
189 The selection of numbers and operation symbols is 3* 6/ 2+ 4=24
190 The parenthesis position is(AB) (CD)
191 The selection of numbers and operation symbols is 3- 2+ 4* 6=24
192 The parenthesis position is(AB) (CD)
193 The selection of numbers and operation symbols is 3- 2- 4* 6=24
194 The parenthesis position is((AB)C)D
195 The selection of numbers and operation symbols is 3- 2* 4* 6=24
196 The parenthesis position is(AB) (CD)
197 The selection of numbers and operation symbols is 3- 2* 4* 6=24
198 The parenthesis position is(AB) (CD)
199 The selection of numbers and operation symbols is 3- 2/ 4* 6=24
200 The parenthesis position is(A(BC))D
201 The selection of numbers and operation symbols is 3* 2+ 4+ 6=24
202 The parenthesis position is(AB) (CD)
203 The selection of numbers and operation symbols is 3- 2+ 6* 4=24
204 The parenthesis position is(AB) (CD)
205 The selection of numbers and operation symbols is 3- 2- 6* 4=24
206 The parenthesis position is((AB)C)D
207 The selection of numbers and operation symbols is 3- 2* 6* 4=24
208 The parenthesis position is(AB) (CD)
209 The selection of numbers and operation symbols is 3- 2* 6* 4=24
210 The parenthesis position is(AB) (CD)
211 The selection of numbers and operation symbols is 3- 2/ 6* 4=24
212 The parenthesis position isA((BC)D)
213 The selection of numbers and operation symbols is 3* 2* 6- 4=24
214
215 [Done] exited with code=0 in 0.268 seconds
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Fence 1