

Re: Help with Permutations

Source: <http://sci.tech-archive.net/Archive/sci.math/2006-01/msg00902.html>

- *From:* quasi <quasi@xxxxxxx>
 - *Date:* Sun, 08 Jan 2006 05:10:00 -0500
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On Sat, 7 Jan 2006 15:08:19 +0000 (UTC),
mareg@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx () wrote:

>In article <1136584344.300707.31850@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx>,
> "barliow" <jack.c.barlow@xxxxxxxxxx> writes:
>>Hi all,
>>
>>I'm not mathematically fantastic so I hope this makes sense.
>>
>>I've written an algorithm to generate all permutations of words from a
>>given alphabet.
>>
>>Alphabet:
>>
>>"abc"
>>
>>Gives permutations:
>>
>>a, b, c, ab, ac, ba, bc, ca, cb, abc, acb, bac, bca, cab, cba
>>
>>In order to keep track of the progress through the algorithm, I need to
>>be able to calculate the total number of permutations in advance. I can
>>do this using the following formula:
>>
>>Number of permutations of size k taken from n objects is:
>>
>>n!
>>n_P_k = -----
>>(n - k)!
>>
>>So I can calculate the total number of permutations off all lengths as:
>>
>>P = (3! / (3! - 1!)) + (3! / (3! - 2!)) + (3! / (3! - 3!)) = 15
>>
>>However, the algorithm is designed to eliminate repeated permutations
>>that arise as a result of having repeated letters:
>>
>>Alphabet:
>>

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```
>>"acc"  
>>  
>>Gives permutations:  
>>  
>>a, c, ac, ca, cc, acc, cac, cca  
>>  
>>This means that the formula above no longer works. I'm wondering if  
>>someone can provide a formula to calculate the total of number of  
>>permutations of *all* lengths that will be outputted in the following  
>>scenarios:  
>>  
>>"abc" (should = 15)  
>>  
>>"accd" (should = 34)  
>>  
>>"accdde" (uncertain as to what the result should be)  
>>  
>  
>I don't know a closed formula for this total number (which is not to say  
>that there isn't one!) but it is not difficult to calculate it.  
>  
>Suppose  $k_1, k_2, \dots, k_r$  are the numbers of each of the distinct letters  
>in your string. (For example, for "accdde",  $k_1=1, k_2=3, k_3=k_4=2$ .)  
>Then the total number of what you describe above as "permutations" is  
>(view this in fixed width font):  
>  
> k1 k2 kr  
> --- ---  
> \\\ (i1 + i2 + ... + ik)!  
>>> . . . > ----- - 1  
> /// i1! i2! ... ik!  
> --- ---  
> i1=0 i2=0 ik=0  
>  
>(The -1 at the end is to avoid counting the empty string, which corresponds  
>to  $i_1=i_2=\dots=i_r=0$  in the sum.)  
>  
>You should be able to write a program to evaluate this expression for given  
> $k_1, k_2, \dots, k_r$ . Doing it for the example above,  $k_1=1, k_2=3, k_3=k_4=2$   
>gives 1265, as quasi reported.  
>  
>Derek Holt.
```

I implemented your iterated sum formula using Maple 9.5.

For the string "accdde", my first attempt at implementing the formula yielded, instead of 1265, a rather surprising answer:

```
549831041606246399
```

Obviously the above answer is way too big, so I tried to find the bug

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in my program. I couldn't find it.

Since my first program was implemented as a function rather than as a procedure, I decided to try rewriting it as a procedure instead. Same incorrect result.

I did finally work around the error to get the correct answer, but I still can't find the source of the error in the first 2 attempts.

At this point, I now think it's a Maple bug, but if it's my bug, perhaps someone could tell me where I went wrong.

Here are the 2 implementations both of which gave the same incorrect result: 549831041606246399

Program #1:

```
f:=(k1,k2,k3,k4)->
Sum(
Sum(
Sum(
Sum((i1+i2+i3+14)!/(i1!*i2!*i3!*i4!),
i4=0..k4),
i3=0..k3),
i2=0..k2),
i1=0..k1)-1;

f(1,3,2,1);
value(%);
```

Program #2:

```
g:=proc(k1,k2,k3,k4)
local s,i1,i2,i3,i4;
s:=0;
for i1 from 0 to k1 do
for i2 from 0 to k2 do
for i3 from 0 to k3 do
for i4 from 0 to k4 do
s:=s+(i1+i2+i3+14)!/(i1!*i2!*i3!*i4!);
od;
od;
od;
od;
s-1;
end;

g(1,3,2,1);
```

Could someone please verify the bug? Is it my bug or Maple's bug?

quasi

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- ***Follow-Ups:***
 - ◆ ***Re: Help with Permutations***
 - ◇ *From:* quasi

 - ***References:***
 - ◆ ***Help with Permutations***
 - ◇ *From:* barliow
 - ◆ ***Re: Help with Permutations***
 - ◇ *From:*

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