

Re: can't solve an exercise—help me with it

Source: <http://coding.derkeiler.com/Archive/Python/comp.lang.python/2006-01/msg01802.html>

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 - *Date:* Thu, 12 Jan 2006 00:34:12 -0500
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In article <43c5e027\$0\$2459\$edfadb0f@xxxxxxxxxxxxxxxxxxxxxxxxxxxx>, "hossam" <nono@xxxxxxxxxxxx> wrote:

> I'm studying python newly and have an exercise that is difficult for me as a
> beginner. Here it is :
> "Write a program that approximates the value of pi by summing the terms of
> this series:
> 4/1-4/3+4/5-4/7+4/9-4/11+.... The program should prompt the user for n, the
> number of terms to sum and then output the sum of the first n terms of this
> series."
>
> any help would be appreciated.
>
> benni

The series you're describing is basically expanding the Taylor series for $4 * \text{atan}(1)$, where

$$\text{atan}(1) = \sum_{i=0}^{\infty} \frac{(-1)^i}{2i+1}$$

(or in LaTeX: $\sum_{i=0}^{\infty} \frac{(-1)^i}{2i+1}$)

To enumerate the terms of this series, you can treat i as a counter, and compute the numerator and denominator either directly or from their previous values. The sum can be accumulated into a separate variable. So, for instance,

```
.. sum = 0. ; num = 1. ; den = 1.  
.. for i in xrange(n):  
.. sum += num / den  
.. num = -num  
.. den += 2  
..  
.. pi = 4 * sum # approximately...
```

Keep in mind that this approximation for $\text{atan}(1)$ converges very slowly,

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so you will need to do quite a lot of terms before it will converge (you need about a thousand terms to get 2 significant figures after the decimal point). You might have better results using Machin's formula,

$$\operatorname{atan}(1) = 4 * \operatorname{atan}(1/5) - \operatorname{atan}(1/239)$$

Or, $\pi = 16 * \operatorname{atan}(1/5) - 4 * \operatorname{atan}(1/239)$. The Taylor series will converge more quickly for $\operatorname{atan}(1/5)$ and $\operatorname{atan}(1/239)$.

(LaTeX: $\operatorname{atan}(x) = \sum_{i=0}^{\infty} \frac{(-1^i)x^{2i+1}}{2i+1}$)

Cheers,
-M

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• **References:**

- ◆ ***can't solve an exercise—help me with it***
◇ From: hossam

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