

Re: A trap: TWO HOWLERS in Mathematica 6 making a dangerous match

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On Jun 16, 7:57 pm, Vladimir Bondarenko <v...@xxxxxxxxxxxxxxxx> wrote:

(* A freshman – or a biologist etc – tries to calculate a divergent integral not realizing that it diverges... *)

```
Integrate[(1+z) Sin[z]/z, {z, 0, Infinity}]
```

(* Mathematica 6 returns an invalid answer, – but without any warning message, the first defect. *)

```
(2+Pi)/2
```

```
%//N
```

```
2.5708
```

(* The customer has heard about some Vladimir and his VM machine and realizes already that computer algebra systems tend to have bugs, so he or she tries to verify the above result via a quadrature... *)

```
NIntegrate[(1+z) Sin[z]/z,{z,0,Infinity}]
```

(* ... and encounters yet another Mathematica 6 eerie defect – not a only a finite number is given – again without any warning message which is itself a bug... – but this number coincides identically with the approximation of the exact answer... nothing to add. *)

```
2.5708
```

This is, I think, an interesting phenomenon from the point of view of both symbolic and numeric calculus. I don't claim to fully understand it but, having encountered it over the years, I can say a bit. The first trouble, for both symbolic and numeric integration, is the failure to detect divergence. But why do such disparate methods then give numerically equivalent results? This is because some singularity–

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crushing quadrature schemes have the effect, in cases of divergent integrals, of giving a finite result that agrees with the generalized integral (that is, the result of removing singular parts e.g via series expansion).

I guess this feature of quadrature can be a blessing or a curse. It depends on whether you are striving for a numerical evaluation of a generalized integral, or trying to double-check your symbolic result and wanting to know if in fact it diverges (or using a symbolic computation to check your numeric routine).

While I'd not refer to the problems indicated herein as howlers, it is generally acknowledged that this phenomenon can be a dangerous match. I hope I'm stating the obvious here.

Best wishes,

Vladimir Bondarenko

VM and GEMM architect
Co-founder, CEO, Mathematical Director

<http://www.cybertester.com/> Cyber Tester, LLC <http://maple.bug-list.org/> Maple Bugs
Encyclopaedia <http://www.CAS-testing.org/> CAS Testing

P.S.

Hummm... shouldn't I give a call to Wolfram Research
and offer them to rely upon my famous VM machine?

It would be quite redundant. I'm fairly certain (I'll verify when I have more time) that this is a simple failure of the convergence testing code. The deficiencies therein are vast, at least where growing and oscillatory factors coexist. About all I'll say is I think it has improved over time. I wouldn't even put money on that.

The point is not to further test what we know is held together by spit and frayed bailing wire; we have testing a-plenty to tell us this. The point is to figure out the algorithms, or, failing that, better heuristics, to improve on the current status.

P.P.S.

Guess... how many Mathematica 6 defects the VM machine
has already calculated? :-)

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P.P.P.S.

My birthday, Jun 19, is closer and closer...

Daniel Lichtblau
Wolfram Research