Laplace

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Chapter 1

Laplace

1.1 internal

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7) The internal processing

   This chapter  describes  the  internal  processing of  Laplace.  I  try  to
explain, how Laplace works  and which algorithms are  used. Usually you  don't
need these informations, but if you  want to do some more complex  operations,
this could be interesting.


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                  Preface

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1.2 internalintro

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- Laplace Manual ---------------------------------------------------- Preface -

7.1) Preface

   Laplace has been written in C++.

   I used the following tools to create Laplace:
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- MUI V3.8 by Stefan Stuntz (see also Readme.mui).
- GCC V2.7.2 by the Free Software Foundation.
- ENFORCER V37 by Michael Sinz.
- GOLDED V4 by Dietmar Eilert.
- TEXAS V0.1 by myself.

1.3 internalnumint

- Laplace Manual ------------------------------------- Numerical integration -

7.2) Numerical integration

If you apply the operation nint() to an integral, Laplace uses an adaptive, non-recursive simpson-rule, to perform the numerical integration. This means that the interval is devided in several sub-intervals and the value of each sub-internal is calculated by a linear approximation of the function.

Laplace starts with the given interval a...b and calculates the area of the trapezium using the formula I(a,b) = 1/2 * (f(b) + f(a)) / (b - a) . Then the interval is splitted at the median c = 1/2 * (b + a) an the area of each sub-interval I(a,c) , I(c,b) is calculated by the same formula as above. If the difference between the interval I(a,b) and the sum of the two sub-intervals I(a,c) + I(c,b) is smaller than 10^(-n), where n is the precision specified by the option $intprec, the calculation is finished and the result is I(a,b) . If the difference is larger, the same procedure is applied to each sub-interval, which are splitted into sub-intervals until the given precision is reached.

To avoid recursion, Laplace puts the sub-intervals onto a stack and processes on after the other, either putting two new intervals onto the stack or adding the calculated value to the final result, until the stack is empty.

As you can see, the demanded precision $intprec is not the maximum difference between the final result and the real value of the integral, as you might think. The error might be much bigger, because each sub-interval has a maximum deviation of 10^(-n) and Laplace usually have to create a lot of sub-intervals.