OpenMath Content

Dictionaries

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Thematic Network
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As usual, all errors are mine.

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Bug fixes: differentiation

<OMS name="diff" cd="calculus1"/> denotes a single differentiation. However, we cannot express \( \frac{d^n}{dx^n} \). The network is therefore proposing to the OpenMath Society that the calculus1 CD be extended by an nthdiff symbol, as follows for \( \frac{d^2}{dx^2}x^3 \).

<OMA>
  <OMS name="nthdiff" cd="calculus1"/>
  <OMI> 2 </OMI>
  <OMBIND>
    <OMBVAR>
      <OMV name="x"/>
    </OMBVAR>
    <OMA>
      <OMS name="power" cd="arith1"/>
      <OMV name="x"/>
      <OMI> 3 </OMI>
    </OMA>
  </OMBIND>
</OMA>
General extensions proposed.

• A transc2 CD, with a binary arctan operator corresponding to the FORTRAN \texttt{atan2} function. Added functionality.

• Extensions to list2: reverse, append, nth — possibly more..

• \texttt{logic3} to encode formal proofs and deductions. More probably needed here.
Changes to Polynomials

poly Add leading_coefficient and coefficient.

polyd Add a new constructor poly_ring_d_named which names (rather than numbers) the variables.

Add new attribute completely_reduced

Rename groebner_basis as groebnered.

Add new orderings matrix_ordering and weighted.

Add a new operation weighted_degree.
Units and Dimensions

• *dimensions1* CD — essentially complete.

• *units_metric1* CD — largely complete but more FMPs need adding.

• *units_imperial1* CD — many FMPs supporting conversion into metric need adding.
cauchypv \textbf{CD} Symbols defeat and (locating the problems) defeat_singularities.

odesoln1 \textbf{CD} Symbol ODEsolution:

1. two bound variables: the solution and the independent variable;

2. The ordinary differential equation;

3. List of initial conditions.

contour1 \textbf{CD} Symbol path_description, as (constraints on) a function $[0, 1] \rightarrow \mathbb{C}$.

How to encode analytic continuation?
Special functions — examples

airy $CD$ $Ai$, $Ai2$, $Bi$, $Bi2$.

errorint $CD$ $erf$, $erfc$, $FresnelS$, $FresnelC$, $w$.

gamma $CD$ $Gamma$ (so far). Problems found in Abramowitz & Stegun.

Bessel $CD$ $J$ and $Y$. How many other variants should we encode?
Future work on CDs: Abstract Algebra

Many more CDs need to be written and/or formalised in this area. Here too, there are problems of consistency:

**Degree** $S_{12}, M_{12}$ are permutation groups acting on 12 symbols;

**Size** $F_{20}$ is a permutation group of size 20, normally acting on 5 elements;

**Unclear** Is $D_{12}$ a group with 12 elements acting on six points, or a group with 24 elements acting on 12 points? One can find both in the literature, though the second is probably more common. It would make sense to follow Conway et al.

OpenMath also needs to deal with ideals etc., rather than just lists of polynomials (different lists can represent the same ideal).
Future Work on CDs: other

**Algorithms** A CD to describe algorithmic concepts would be useful, partly from the point of view of the wider publication-related aspects of OpenMath, and partly for use in concepts such as symbolic differentiation, i.e. differentiating an algorithm, where co-operation between software packages is important.

**Logics** While basic classical logic (propositional, predicate) is catered for, there is nothing on more general proofs, or other forms of logic (intuitionistic etc.). Different concepts of equality also need to be handled.

**Special Functions** Much more work needs to be done here, but this should become easier once the infrastructural issues are solved.