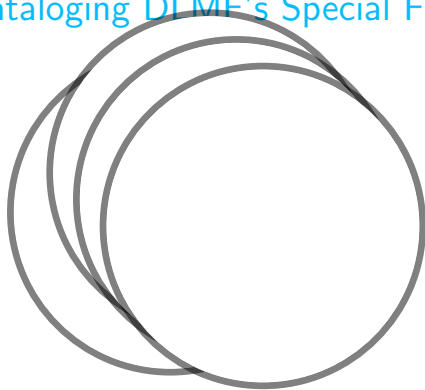
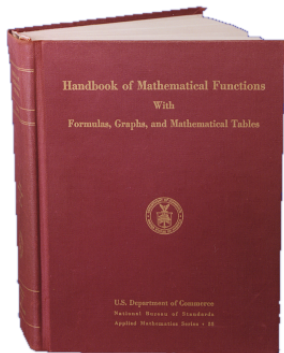


Cataloging DLMF's Special Functions





*D*igital
*L*ibrary of
*M*athematical
*F*unctions

Continuing evolution

Background

Metadata

Computable Mathematics?

Functions

- ▶ Quarterly releases
- ▶ Errata
- ▶ Clarifications
- ▶ Additional material (New chapter)
- ▶ Other improvements. . .

Very brief tour

Background

Metadata

Computable
Mathematics?

Functions

- ▶ 3D Visualizations
- ▶ Metadata

For Humans . . . till now

Background

Metadata

Computable Mathematics?

Functions

- ▶ Preserve the character of a Handbook
- ▶ more than *Book on the Web*
- ▶ Not a CAS or ATP on the Web.

Next Goal: Machine-Readable

Background

Metadata

Computable
Mathematics?

Functions

- ▶ Find
- ▶ Use

Metadata

Background

Metadata

Computable
Mathematics?

Functions

- ▶ Layered information for Humans
- ▶ Discoverability for Machines

- ▶ Annotations
- ▶ Sources
- ▶ Classification as Addition Theorem, Asymptotic Expansion, . . .
- ▶ Alternative representations

Finding Information

Background

Metadata

Computable
Mathematics?

Functions

- ▶ Search engines use Schema.org
- ▶ Leverage ontologies for traceability, quotation, attribution?
- ▶ Not much for science/math there
Need mathematical ontologies
- ▶ Wolfram has some
- ▶ What ontologies would cover *interesting* relations?

Would be good to interoperate, collaborate!

Computable

Background

Metadata

Computable
Mathematics?

Functions

- ▶ Content MathML,
or OpenMath, Mathematica, Maple, ...

Promises, promises. . .

- ▶ Metadata: types, constraints, ...

But how?

Background

Metadata

Computable
Mathematics?

Functions

- ▶ Ambiguities of notation, . . .
- ▶ What *are* these 'functions', exactly?

Culture Clash

Background

Metadata

Computable
Mathematics?

Functions

Classisicts:

- ▶ Hesitance to pin down *one* 'definition'
(Beautiful Mathematics often derives from showing two apparently different things are the same.)
- ▶ Hesitance to specify branch cuts
depends!
- ▶ Multivalued 'functions'

Computational:

- ▶ single, clear definition
- ▶ single-valued

Need to sympathize with both views.

Moving forward

Background

Metadata

Computable
Mathematics?

Functions

- ▶ Not insurmountable
- ▶ Mostly tedious
- ▶ occasionally subtle and non-trivial especially for amateur mathematicians.

Special Functions

- ▶ We have some (hundreds)
- ▶ Wolfram has some, too
- ▶ Maplesoft, NAG, others
- ▶ would be good to interoperate!

But, when are functions the *Same*? How do they differ?

Signatures

Background

Metadata

Computable
Mathematics?

Functions

- ▶ signatures, domains, codomains
- ▶ simple: $\mathbb{C} \mapsto \mathbb{C}$
- ▶ list poles, undefined, ...?
- ▶ extensions, generalizations

Argument 'meaning'

Background

Metadata

Computable
Mathematics?

Functions

- ▶ Conceptually the same, but...
- ▶ Weierstrass functions defined on lattices, vs invariants
$$\wp(z; g_2, g_3) = \wp(z|\mathbb{L})$$
- ▶ Elliptic functions functions k versus m .
$$\operatorname{sn}(u, k) = \operatorname{sn}(u, m)$$

Cuts, Multivalued

Background

Metadata

Computable
Mathematics?

Functions

- ▶ single-valued, multi-valued 'functions' (or double!?)
- ▶ different branch cuts

Extras & Esoterica

Background

Metadata

Computable
Mathematics?

Functions

- ▶ Do derivatives warrant 1st class?
- ▶ zeros, envelopes, ...?
- ▶ common vs esoteric

Plan

Background

Metadata

Computable
Mathematics?

Functions

- ▶ finding the information
- ▶ representation and encoding it
- ▶ discuss, refine, iterate
- ▶ publishing it