Math Object Identifiers
Towards Research Data in Mathematics

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Take-Home Message (I will probably run out of time)

- Math is working towards a "Global Digital Math Library"
- There are more sources of Math Knowledge than you think
  - arXMLiv preprints and zbMATH Abstracts (licensing problems)
  - OEIS: "Encyclopedia of integer Sequences" (`https://oeis.org`)
  - LMFDB "L-functions and Modular Forms DB" (`http://lmfdb.org`)
- But we need translation and aggregation methods
  - But shallow methods are problematic ($\mathbf{P} = \mathbf{NP}$ vs. $\mathbf{P} \neq \mathbf{NP}$)
- maybe it is time to try very lightweight methods as well
- Math Object Identifiers (enabling technology for LOD)
  - MOIs reference published, persistent, definitional document fragments
  - Applications: search, classification, recommender systems, data bases,...
  - need an organization to support this and lend credibility. (IMKT? OpenMath?)
- Kickstarting MOIs by annotating CICM papers (did not work so well in 2018)
- we will try again in 2018 (better documentation of MOI

MOI Examples (DOI-Based Definition)

- DOI-based MOs

MON	4711
MOIDate	2017-11-1
MODRef	DOI: 10.1007/s11511-008-0029-0 # Definition 3.4
Type	Definition
BibRef	Acta Math., 201 (2008), 1-82 p. 12
See	http://projecteuclid.org/download/pdf_1/euclid.acta/1485891992
Snippet	*Definition* 3.4. For every real-analytic submanifold $F \subset V$, every $a \in F$ and every $r \in \mathbb{N}$, put (i) $K_a^0 F := T_a F$, and define (ii) $K_a^{r+1} F$ to be the space of all vectors $v \in K_a^r F$ such that there is a smooth mapping $f: V \to V$ with $f'(a)(T_a F) \subset K_a^r F$, $f(a) = v$ and $f(x) \in K_x^r F$ for all $x \in F$.

MOI Examples (DOI-Based Theorem)

- DOI-based MOs

MON	4712
MOIDate	2017-11-1
MODRef	DOI: 10.1007/s11511-008-0029-0 # Corollary 3.6
Type	Theorem
BibRef	Acta Math., 201 (2008), 1-82 p. 13
See	http://projecteuclid.org/download/pdf_1/euclid.acta/1485891992
Note	A condition that a tube manifold is non-degenerate.
Snippet	Corollary 3.6. *Suppose that* $\dim F \geqslant 2$ *and* $K_x F = \mathbb{R}x$ *for all* $x \in F$. *Then* F *is affinely 2-nondegenerate at every point.*

MOI Examples (DOI-Based Definition)

- DOI-based MOs

`MON`	4713
`MOIDate`	2017-11-2
`MODRef`	DOI: 10.1007/s11511-008-0029-0 # proof of Corollary 3.6
`Type`	Proof
`BibRef`	Acta Math., 201 (2008), 1-82 p. 13
`See`	`http://projecteuclid.org/download/pdf_1/euclid.acta/1485891992`
`Note`	a simple three-line proof.
`Snippet`	*Proof.* The map $f=\mathrm{id}$ has the property that $f(x)\in K_xF$ for every $x\in F$. Hence, the relation $f'(x)(T_xF)=T_xF\not\subset K_xF$ implies that $x\notin K_x^2F$ and thus $K_x^2F=0$ as well as $x\neq 0$. In particular, F is uniformly degenerate. $\square$

References I