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4
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[Book] *IntroductiontoVassilievKnotInvariants,* byS.Chmutov,S.Duzhin,andJ. Mostovoy,CambridgeUniversityPress,CambridgeUK,2012,xvi+504pp.,hardback,$70.00, ISBN978-1-10702-083-2.

Merely30yearsago,ifyouhadaskedeventhebestinformedmathematicianaboutthe relationshipbetweenknotsandLiealgebras,shewouldhavelaughed,forthereisn'tand therecan'tbe.Knotsareflexible,Liealgebrasarerigid.Knotsareirregular,Liealgebras aresymmetric.Thelistofknotsisalengthymess,thecollectionofLiealgebrasiswell-organized.Knotsareusefulforsailors,scouts,andhangmen,Liealgebrasfornavigators, engineers,andhighenergyphysicists.Knotsarebluecollar,Liealgebrasarewhite.They areassimilaraswormsandcrystals.

Theninthe1980scameJones,andWitten,andReshetikhinandTuraev[Jo,Wi,RT]and showedthatifyoureallyarethebestinformed,andyouknowaboutquantumfieldtheory andconformalfieldtheoryandquantumgroups,thenyouknowthatthetwodisjointfields areinfactintricatelyrelated.This"quantum"approachremainsthemostpowerfulwayto getcomputableknotinvariantsoutof(certain)Liealgebras(andrepresentationsthereof). Yetshortlylater,inthelate80sandearly90s,analternativeperspectivearoused,thatof "finite-type"or"Vassiliev-Goussarov"invariants[Va1,Va2,Go1,Go2,BL,Ko1,Ko2,BN1], whichmadethesurprisingrelationshipbetweenknotsandLiealgebrasappearsimpleand almostinevitable.

Thereviewedbookisaboutthatalternativeperspective,theonereasonablesounding butnotentirelytrivialtheoremthatisneededwithinit(the"fundamentaltheorem"orthe "Kontsevichintegral"REFHERE?),andthemanythreadsthatbeginwiththatperspective. Letmestartwithabriefsummaryofthemathematics,andevenbefore,averybriefsummary.

Theverybriefsummaryisthatinsomecombinatorialsenseitmakessenseto"differentiate"knotinvariants,andhenceitmakessensetotalkabout"polynomials"onthespaceof knots—thesearefunctionsonthesetofknots(meaning,knotinvariants)whosesufficiently highderivativesvanish.Suchpolynomialscanbefairlyconjecturedtoseparateknots— elsewhereinmathinluckycasespolynomialsseparatepoints,andinourcase,specificcomputationsareencouraging.Also,suchpolynomialsaredeterminedbytheir"coefficients", andeachofthese,bytheone-side-easy"fundamentaltheorem",isalinearfunctionalon somefinitespaceofgraphsmodulorelations.Thesesamegraphsturnouttoparameterize formulasthatmakesenseinawideclassofLiealgebras,andthesaidrelationsmatchexactly withtherelationsinthedefinitionofaLiealgebra—anti-symmetryandtheJacobiidentity. Hencewhatismoreorlessdualtoknots(invariants),isalso,afterpassingtothecoefficients, moreorlessdualtoLiealgebras.QED,andontothebriefsummary[1].

Let V beanarbitraryinvariantoforientedknotsinorientedspacewithvaluesinsome Abeliangroup A.Extend V tobeaninvariantof1-singularknots,knotsthatmayhavea singlesingularitythatlocallylookslikeadoublepoint ,usingtheformula

(1) $$V(\quad)= V(!) - V('') .$$

2010 *MathematicsSubjectClassification.* Primary57M25.

TEXat http://drorbn.net/AcademicPensieve/2013-01/CDMReview/,copyleftat http://www.math.toronto.edu/~drorbn/Copyleft/

[1]Partiallyself-plagiarizedfrom[BN2].

1

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Import["4T.pdf"]
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