Curriculum Vitae: Jack Jeffries

https://jack-jeffries.github.io/

Associate Professor, University of Nebraska-Lincoln.

Ph. D.: The University of Utah, May 2015. Advisor: Professor Anurag K. Singh

B. S.: The Ohio State University, June 2010.

Appointments:

- Associate Professor, University of Nebraska-Lincoln, 2024–.
- Assistant Professor, University of Nebraska-Lincoln, 2020–2024.
- MSRI Research Member, 2024.
- Investigador Titular A (tenure-track faculty), CIMAT, 2019–2020.
- NSF Postdoctoral Fellow, The University of Michigan, 2016–2019.
- RTG Assistant Professor, The University of Michigan, 2015–2016.
- Graduate Teaching/Research Assistant, The University of Utah, 2010–2015.
- Graduate Research Fellow, The University of Utah, 2014–2015.
- MSRI Program Associate, 2012–2013.
- Undergraduate Teaching Assistant, The Ohio State University, 2008–2010.

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Research Interests:

My research interests are in Commutative Algebra. More particularly, my interests include differential operators, p-derivations, invariant theory, positive characteristic techniques, local cohomology, generalized multiplicities, symbolic powers, and applications to neuroscience. My research is supported by NSF CAREER Award DMS-2044833.

Publications and Preprints:

(1) Uniformity in nonreduced rings via Noetherian operators, with Yairon Cid-Ruiz, submitted, 8 pp., arXiv:2404.02057
(2) Sandwich Bernstein-Sato polynomials and Bernstein's inequality, with David Lieberman, submitted, 36 pp., arXiv:2403.13146
(3) Differentiating by prime numbers, *Notices of the American Mathematical Society*, **70** (2023), no. 11, 1772–1779.
(4) Local cohomology of modular invariant rings, with Kriti Goel and Anurag K. Singh, to appear in *Transformation Groups*, 12 pp., arXiv:2306.14279
(5) When are the natural embeddings of classical invariant rings pure?, with Melvin Hochster, Vaibhav Pandey, and Anurag K. Singh, *Forum of Mathematics, Sigma*, **11** (2023), e67.
(6) Resolutions of differential operators of low order for an isolated hypersurface singularity, with Rachel N. Diethorn, Claudia Miller, Nicholas Packauskas, Josh Pollitz, Hamidreza Rahmati, and Sophia Vassiliadou, to appear in *Michigan Mathematical Journal*, 53 pp., arXiv:2209.13110

(7) Nash blowups of toric varieties in prime characteristic, with Daniel Duarte and Luis Núñez-Betancourt, to appear in *Collectanea Mathematica*, 13 pp., arXiv:2208.05599
(8) Bernstein-Sato theory for singular rings in positive characteristic, with Luis Núñez-Betancourt and Eamon Quinlan-Gallego, *Transactions of the American Mathematical Society*, **376** (2023), no. 7, 5123–5180.
(9) Bernstein-Sato polynomials in commutative algebra, with Josep Àlvarez Montaner and Luis Núñez-Betancourt, *Commutative Algebra* (2021), 1–76, Springer.
(10) A Jacobian criterion for nonsingularity in mixed characteristic, with Melvin Hochster, to appear in *American Journal of Mathematics*, 26 pp., arXiv: 2106.01996
(11) A uniform Chevalley theorem for direct summands of polynomial rings in mixed characteristic, with Alessandro De Stefani and Eloísa Grifo, *Mathematische Zeitschrift*, **301** (2022), 4141–4151.
(12) Bernstein's inequality and holonomicity for certain singular rings, with Josep Àlvarez Montaner, Daniel J. Hernández, Luis Núñez-Betancourt, Pedro Teixeira, and Emily E. Witt, to appear in *International Mathematics Research Notices. IMRN*, 34 pp., arXiv:2103.02986
(13) Differential operators on classical invariant rings do not lift modulo p, with Anurag K. Singh, *Advances in Mathematics*, **432** (2023), 109276, 53 pp.
(14) Extensions of Primes, Flatness, and Intersection Flatness, with Melvin Hochster, *Commutative Algebra: 150 years with Roger and Sylvia Wiegand*, (2021), 63–81.
(15) Lower Bounds on Hilbert-Kunz Multiplicities and Maximal F-signatures, with Yusuke Nakajima, Ilya Smirnov, Kei-ichi Watanabe, and Ken-ichi Yoshida, *Mathematical Proceedings of the Cambridge Philosophical Society*, **174** (2023), 247–271.
(16) Faithfulness of top local cohomology modules in domains, with Melvin Hochster, *Mathematical Research Letters*, **27** (2020), no. 6, 1755–1765.
(17) Bernstein-Sato functional equations, V-filtrations, and multiplier ideals of direct summands, with Josep Àlvarez Montaner, Daniel J. Hernández, Luis Núñez-Betancourt, Pedro Teixeira, and Emily E. Witt, *Communications in Contemporary Mathematics* **22** (2022), 40 pp.
(18) A transformation rule for natural multiplicities, with Ilya Smirnov, *International Mathematics Research Notices. IMRN* (2022), no. 2, 999–1015.
(19) Derived functors of differential operators, *International Mathematics Research Notices. IMRN*, 2021, no. 7, 4920–4940.
(20) Polarization of neural ideals, with Sema Güntürkün and Jeffrey Sun, *Journal of Algebra and Its Applications*, **19** (2020), 2050146, 15 pp.
(21) Quantifying singularities with differential operators, with Holger Brenner and Luis Núñez-Betancourt, *Advances in Mathematics*, **358** (2019), 106843, 89 pp.
(22) Algebraic signatures of convex and nonconvex codes, with Carina Curto, Elizabeth Gross, Katherine Morrison, Zvi Rosen, Anne Shiu, and Nora Youngs, *Journal of Pure and Applied Algebra*, **223** (2019), 3919–3940.
(23) A Zariski–Nagata theorem for smooth $\mathbb{Z}$-algebras, with Alessandro De Stefani and Eloísa Grifo, *Journal für die reine und angewandte Mathematik*, **761** (2020), 123–140.
(24) Local Okounkov bodies and limits in prime characteristic, with Daniel J. Hernández, *Mathematische Annalen* **372** (2018), no. 1, 139–178.
(25) Mapping toric varieties into low dimensional spaces, with Emilie Dufresne, to appear in *Transactions of the American Mathematical Society*, 28 pp., arXiv:1602.07585
(26) Appendix to: On the behavior of singularities at the F-pure threshold, with Alessandro De Stefani, Jack Jeffries, Zhibek Kadyrsizova, Robert Walker, George Whelan; paper by Eric

Canton, Daniel Hernández, Karl Schwede, Emily Witt, *Illinois Journal of Mathematics* **60** (2016), no. 3, 669–685.

(27) What makes a neural code convex?, with Carina Curto, Elizabeth Gross, Katherine Morrison, Mohamed Omar, Zvi Rosen, Anne Shiu, and Nora Youngs, *SIAM Journal of Applied Algebraic Geometry* **1** (2017), no. 1, 222–238.

(28) Separating invariants and local cohomology, with Emilie Dufresne, *Advances in Mathematics*, **270** (2015) 565–581.

(29) Multiplicities of classical varieties, with Jonathan Montaño and Matteo Varbaro, *Proceedings of the London Mathematical Society*, **110** (2015), no. 4, 1033–1055.

(30) Non-simplicial decompositions of Betti diagrams of complete intersections, with Courtney Gibbons, Sarah Mayes, Claudiu Raicu, Branden Stone, and Bryan White, *Journal of Commutative Algebra*, **7** (2015), no. 2, 189–206.

(31) The j-multiplicity of monomial ideals, with Jonathan Montaño, *Mathematical Research Letters*, **20** (2013) no. 4, 1–16.

Ph.D. Students:

- David Lieberman, 2024
- Jordan Barrett, current
- Nawaj KC, coadvised with Mark Walker, current
- Taylor Murray, current
- Shalom Echalaz, coadvised with Tom Marley, current
- Cleve Young, current

Undergraduate and masters Students:

- Luis Palacios, Masters, coadvised with Luis Núñez Betancourt, CIMAT, 2020.
- Sandra Sandoval, Licenciatura, coadvised with Luis Núñez Betancourt, CIMAT, 2020.
- Kasey Brabec, Undergraduate Practicum, 2023.
- Shelby Castle, Undergraduate Practicum, 2022.
- Uyen Tran, REU, coadvised with Eloísa Grifo, UNL, 2022.
- Fangu Chen and Alan Tang, REU, coadvised with Eric Canton and Eloísa Grifo, UM, 2019.
- Jeffrey Sun, REU, coadvised with Sema Güntürkün, UM, 2016.

Grants and Fellowships:

- NSF RTG award DMS-2342256 "Commutative Algebra at Nebraska" co-PI, 2024–2028.
- NSF CAREER award DMS-2044833 "CAREER: Differential Operators and p-Derivations in Commutative Algebra" 2021–2026.
- NSF Conference grant DMS-2220824 "Pan-American School on Commutative Algebra (PASCA 2022)" 2022–2023.
- Sistema Nacional de Investigadores (Mexico), Level I, 2020–.
- UNL Research Development Fellows Program (RDFP), 2020–2021.
- AMS Simons travel grant, 2019–2021.
- AIM SQUARES grant, 2018–2020.
- NSF Postdoctoral Research Fellowship, 2016–2019.
- NSA Young Investigator Grant (awarded) 2016.
- University of Utah Graduate Research Fellowship, 2014–2015.
- T. Benny Rushing Fellowship, University of Utah, 2014.

Teaching:

University of Nebraska-Lincoln

- Fall 2024: Math 905 Commutative Algebra 1
- Fall 2024: Math 325 Elementary Analysis
- Fall 2023: Math 445 Number Theory
- Fall 2023: Math 106 Calculus 1
- Spring 2023: Math 918 Topics in Algebra
- Fall 2022: Math 325 Elementary Analysis
- Fall 2022: Math 221/221H Differential Equations/Honors Differential Equations
- Spring 2022: Math 902 Algebra 2
- Fall 2021: Math 901 Algebra 1
- Fall 2021: Math 325 Elementary Analysis
- Spring 2021: Math 325 Elementary Analysis
- Fall 2020: Math 314 Linear Algebra

CIMAT

- Spring 2020: D-modules and applications to Commutative Algebra
- Fall 2019: Commutative Algebra

The University of Michigan

- Winter 2019: Math 412 Introduction to Abstract Algebra
- Fall 2018: Math 614 Commutative Algebra I
- Winter 2018: Math 615 Commutative Algebra II
- Fall 2017: Math 412 Introduction to Abstract Algebra
- Winter 2016: Math 217 Linear Algebra
- Fall 2015: Math 115 Calculus I

The University of Utah

- Spring 2014: Math 2270 Linear Algebra
- Fall 2013: Math 1070 Introduction to Statistical Inference
- Summer 2013: Math 3160 Applied Complex Variables
- Fall 2011: Math 1220 Calculus II
- Summer 2011: Math 1070 Introduction to Statistical Inference
- Spring 2011: Math 1010 Intermediate Algebra
- Fall 2010: Math 1100 Quantitative Analysis

The Ohio State University

- Winter 2010: Math 150 Elementary Functions
- Autumn 2009: Math 150 Elementary Functions
- Winter 2009: Math 150 Elementary Functions
- Autumn 2008: Math 150 Elementary Functions

Service and Organization:

- Co-organizer: Commutative Algebra Market Preparation workshop, July 2023.
- Co-organizer: Pan-American School on Commutative Algebra, June–July 2022.
- Organizer: UNL Math colloquium, August 2022–.
- UNL AMS Student Chapter Faculty Liaison, August 2021–.
- Organizer: UNL High School Math Circle, Spring 2022–.
- UNL Undergraduate Program Committee, Fall 2020–.
- Co-organizer: Mathematical Congress of the Americas special session, July 2021.

- Co-organizer: Differential Operators in Commutative Algebra Seminar, 2020–2021.
- Co-organizer: AMS Special Session on Advances in Commutative Algebra, Ann Arbor, MI, October 2018.
- MathSciNet reviewer: 2017–present.
- Wolverine Pathways volunteer, 2016–2018.
- Teaching Assistant, OIST Summer Graduate School 2017, Okinawa, Japan, May 2017.
- University of Michigan Math club, Spring 2017.
- REU co-advisor, Summer 2016.
- Wayne County Math Teachers Circle volunteer, Fall 2016.
- Co-organizer: AMS-AWM (JMM) Special Session on Commutative Algebra and Its Interactions with Algebraic Geometry, Seattle, WA, January 2016.
- Program Assistant, MRC Program in Commutative Algebra, June 2015.
- Co-organizer: AMS Special Session on Homological Methods in Commutative Algebra, October 2015.
- Co-organizer: BIKES (University of Utah Commutative Algebra student seminar), Fall 2014.
- Co-organizer: AMS Special Session on Developments from MSRI Programs in Commutative Algebra and Noncommutative Algebraic Geometry and Representation Theory, San Francisco, CA, October 2014.
- Co-organizer: AMS Special Session on Developments from PASI 2012: Commutative Algebra and Interactions with Related Disciplines, Lubbock, TX, April 2014.
- Co-organizer: MSRI Program Associate Seminar, Berkeley, CA, Fall 2012.

Selected Invited Talks:

- *Local cohomology of determinantal nullcones*, Seminar on Commutative Algebra and Algebraic Geometry, Berkeley, CA, February 2024.
- *Local cohomology and invariant theory*, (Lecture series for graduate workshop), Phoenix, AZ, November 2023.
- *Differential operators on singularities*, Commutative Algebra and its Interactions with Algebraic Geometry CMND/SLMath-MSRI Joint Workshop, South Bend, IN, May 2023.
- *Local cohomology of invariant rings*, AMS Spring Sectional Meeting, Cincinnati, OH, April 2023.
- *Local cohomology of invariant rings*, AMS Spring Sectional Meeting, Atlanta, GA, April 2023.
- *Bernstein's inequality for certain singular rings*, Oberwolfach workshop on Resolutions in Local Algebra and Singularity Theory, Oberwolfach, Germany, February 2023.
- *Are determinantal rings direct summands of polynomial rings?*, Texas Algebraic Geometry Symposium, College Station, TX, October 2022.
- *A Jacobian criterion for nonsingularity in mixed characteristic*, CMO workshop on Advances in Mixed Characteristic Commutative Algebra and Geometric Connections, Oaxaca, Mexico, May 2022.
- *Are determinantal rings direct summands of polynomial rings?*, CA+, Ames, IA, April 2022.
- *Are determinantal rings direct summands of polynomial rings?*, University of Minnesota Commutative Algebra Seminar, March 2022.
- *Differentiating by 13*, NMSU Colloquium, Las Cruces, NM (online), February 2022.
- *Differential operators and variation of characteristic*, AMS Fall Sectional Meeting, Albuquerque, NM (online), October 2021.

- *Lifting Frobenius: What, Why, and Who*, AMS Fall Sectional Meeting, Omaha, NE (online), October 2021.
- *A Jacobian Criterion for Nonsingularity in Mixed Characteristic*, SIAM Conference on Applied Algebraic Geometry, College Station, TX (online), August 2021.
- *Bernstein's inequality and holonomicity for certain singular rings*, D-modules, Group Actions, and Frobenius: Computing on Singularities, ICERM, August 2021.
- *A Jacobian criterion for nonsingularity in mixed characteristic*, FRG Special Month On Singularities & K-Stability, May 2021.
- *Differentiating by 13*, UNL Colloquium, February 2021.
- *Faithfulness of top local cohomology modules in domains*, IIT Bombay Virtual Commutative Algebra Seminars, October 2020.
- *Bernstein's inequality on singular rings*, UNL Commutative Algebra seminar, October 2020.
- *Differential operators on classical invariant rings*, AMS Fall Sectional Meeting, El Paso, TX (online), September 2020.
- *Two applications of p-derivations in commutative algebra*, MSRI Fellowship of the Ring online seminar, May 2020.
- *From Zariski-Nagata to local fundamental groups*, Tulane Colloquium, January 2020.
- *From Zariski-Nagata to local fundamental groups*, UNL Colloquium, December 2019.
- *Bernstein-Sato polynomials, V-filtrations, and multiplier ideals*, Workshop on p-adic methods and Hodge theory, Mérida, México, November 2019.
- *Neural rings*, Fall school in Commutative Algebra, Guanajuato, México, November 2019.
- *Differential signature*, Workshop on Algebraic and Topological Methods in Singularity Theory, Guanajuato, México, November 2019.
- *Primary decomposition and differentiating by integers*, Congresso Nacional de Sociedad Matemática Mexicana, Monterrey, México, October 2019.
- *Neural rings*, Coloquio Latinamericano de Álgebra, Mexico City, México, August 2019.
- *Bernstein-Sato polynomials and singularities*, Coloquio Latinamericano de Álgebra, Mexico City, México, August 2019.
- *From Zariski-Nagata to local fundamental groups*, CIMAT Colloquium, Guanajuato, México, February 2019.
- *From Zariski-Nagata to local fundamental groups*, Iowa State Math Department Colloquium, Des Moines, IA, February 2019.
- *Differential operators and reduction to positive characteristic*, FACARD, Barcelona, Spain, January 2019.
- *Lifting differential operators and the unique splitting property*, AMS Fall Sectional Meeting, Ann Arbor, MI. October 2018.
- *Quantifying singularities with differential operators*, KUMUNU, Lawrence, KS, October 2018.
- *A Zariski-Nagata Theorem for smooth $\mathbb{Z}$-algebras*, University of Nottingham Algbera Seminar, Nottingham, UK, July 2018.
- *Differential operators and symbolic powers* (Lecture series), Topics in Commutative Algebra RTG Workshop, Salt Lake City, UT, May 2018.
- *Derived functors of differential operators*, Kansas Commutative Algebra Seminar, Lawrence, KS, April 2018.
- *Derived functors of differential operators*, AMS Spring Sectional Meeting, Nashville, TN, April 2018.

- *Derived functors of differential operators*, AMS Spring Sectional Meeting, Columbus, OH, March 2018.
- *Derived functors of differential operators*, Mini-workshop in Commutative Algebra, Charlottesville, VA, March 2018.
- *A Zariski-Nagata Theorem for smooth $\mathbb{Z}$-algebras*, JMM, San Diego, CA, January 2018.
- *A Zariski-Nagata Theorem for smooth $\mathbb{Z}$-algebras*, Purdue Commutative Algebra Seminar, West Lafayette, IN, October 2017.
- *Quantifying Singularities with differential operators*, AMS Fall Sectional Meeting, Denton, TX, September 2017.
- *Quantifying Singularities with differential operators*, PRIMA, Oaxaca, Mexico, August 2017.
- *Quantifying Singularities with differential operators*, UU Commutative Algebra Seminar, Salt Lake City, UT, April 2017.
- *Local Okounkov bodies and limits in positive characteristic I*, UNL Commutative Algebra Seminar, March 2017.
- *Local Okounkov bodies and limits in positive characteristic II*, UNL Commutative Algebra Seminar, March 2017.
- *Local Okounkov bodies and limits in positive characteristic*, CMS Winter meeting, Niagara Falls, ON, December 2016.
- *Local Okounkov bodies and limits in positive characteristic*, GSU Commutative Algebra Seminar, November 2016.
- *Subspace arrangements in invariant theory*, CIMAT Algebra Seminar, Guanajuato, MX, October 2016.
- *Separating sets for actions of tori*, AMS Spring Sectional Meeting, Salt Lake City, UT, April 2016.
- *Separating sets for actions of tori*, AMS Spring Sectional Meeting, Fargo, ND, April 2016.
- *Separating sets for actions of tori*, AMS Fall Sectional Meeting, New Brunswick, NJ, November 2015.
- *How many invariants are needed to separate orbits?*, Algebra Seminar, University of Edinburgh, February 2015.
- *How many invariants are needed to separate orbits?*, International Conference on Representation Theory, A conference in honor of Jerzy Weyman's 60th Birthday, Storrs, CT, April 2015.
- *How many invariants are needed to separate orbits?*, JMM, San Antonio, TX, January 2015.