Curriculum Vitae: Jack Jeffries

Assistant 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:

- Assistant Professor, University of Nebraska-Lincoln, 2020–.
- 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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325 Avery Hall
Department of Mathematics
University of Nebraska-Lincoln
Lincoln, NE 68588-0130

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) Local cohomology of modular invariant rings with Kriti Goel and Anurag K. Singh, submitted, 12 pp., arXiv:2210.09351
(2) 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.
(3) 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 (provisionally) in *Michigan Mathematical Journal*, 53 pp., arXiv:2209.13110
(4) 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
(5) Bernstein-Sato theory for singular rings in positive characteristic, with Luis Núñez-Betancourt and Eamon Quinlan-Gallego to appear in *Transactions of the American Mathematical Society*, 58 pp., arXiv:2110:00129
(6) Bernstein-Sato polynomials in commutative algebra, with Josep Àlvarez Montaner and Luis Núñez-Betancourt, *Commutative Algebra* (2021), 1–76, Springer.
(7) A Jacobian criterion for nonsingularity in mixed characteristic, with Melvin Hochster, to appear in *American Journal of Mathematics*, 26 pp., arXiv: 2106.01996

(8) 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.

(9) 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

(10) Differential operators on classical invariant rings do not lift modulo p, with Anurag K. Singh, to appear in *Advances in Mathematics*, 38 pp. arXiv:2006.03029

(11) Extensions of Primes, Flatness, and Intersection Flatness, with Melvin Hochster, *Commutative Algebra: 150 years with Roger and Sylvia Wiegand*, (2021), 63–81.

(12) 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.

(13) Faithfulness of top local cohomology modules in domains, with Melvin Hochster, *Mathematical Research Letters*, **27**, (2020), no. 6, 1755–1765.

(14) 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.

(15) A transformation rule for natural multiplicities, with Ilya Smirnov, *International Mathematics Research Notices. IMRN* (2022), no. 2, 999–1015.

(16) Derived functors of differential operators, *International Mathematics Research Notices. IMRN*, 2021, no. 7, 4920–4940.

(17) Polarization of neural ideals, with Sema Güntürkün and Jeffrey Sun, *Journal of Algebra and Its Applications*, **19** (2020), 2050146, 15 pp.

(18) Quantifying singularities with differential operators, with Holger Brenner and Luis Núñez-Betancourt, *Advances in Mathematics*, **358** (2019), 106843, 89 pp.

(19) 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.

(20) 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.

(21) Local Okounkov bodies and limits in prime characteristic, with Daniel J. Hernández, *Mathematische Annalen* **372** (2018), no. 1, 139–178.

(22) Mapping toric varieties into low dimensional spaces, with Emilie Dufresne, to appear in *Transactions of the American Mathematical Society*, 28 pp., arXiv:1602.07585

(23) 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.

(24) 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.

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

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

(27) 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.
(28) The j-multiplicity of monomial ideals, with Jonathan Montaño, *Mathematical Research Letters*, **20** (2013) no. 4, 1–16.

Ph.D. Students:

- David Lieberman, current
- Jordan Barrett, current
- Nawaj KC, coadvised with Mark Walker, current
- Taylor Murray, current
- Shalom Echalaz, 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 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 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:

- *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.