

# Jeffrey Pennington

## Curriculum Vitae

Stanford University  
353 Serra Mall  
Stanford, CA 94025  
☎ (213) 479 8298  
✉ [jpennin@stanford.edu](mailto:jpennin@stanford.edu)

### Research Interests

Artificial intelligence and deep learning, particularly recursive neural networks with applications in natural language processing.

Mathematical properties of perturbative quantum field theory, particularly  $\mathcal{N} = 4$  super-Yang-Mills theory; on-shell scattering amplitudes; multi-loop integrals.

### Education

2007–2013 **Ph.D.**, *Stanford University*, Stanford, CA.  
Theoretical Particle Physics. September 2013.  
Advisor: Lance J. Dixon

2003–2007 **B.S.**, *University of Southern California*, Los Angeles, CA.  
Physics and Mathematics, *summa cum laude*.

### Research Experience

2013–present **Stanford University**, *Stanford, CA*.

Pursued a research program focusing on the mathematical and functional properties of deep learning algorithms as applied to natural language processing. Developed new understanding of the foundational elements of these methods, word representations.  
Advisor: Christopher Manning

2008–2013 **SLAC National Accelerator Laboratory**, *Menlo Park, CA*.

Explored the structure and properties of quantum field theory, with a focus on higher-order calculations, particularly within  $\mathcal{N} = 4$  super-Yang-Mills theory. Developed and applied numerical and analytical techniques to study the structure of infrared divergences in non-abelian gauge theory.  
Advisor: Lance J. Dixon

Spring 2011 **Stanford University**, *Stanford, CA*.

Developed novel machine learning algorithms based on recursive neural networks. Applied these *deep learning* algorithms to achieve state-of-the-art performance in various *sentiment analysis* and *paraphrase detection* tasks in the field of natural language processing.  
Advisor: Andrew Y. Ng

2007–2008 **Stanford Institute for Theoretical Physics**, *Stanford, CA*.

Investigated black holes, information theory, quantum gravity, and the AdS/CFT correspondence.  
Advisors: Shamit Kachru, Leonard Susskind

Spring 2008 **Kavli Institute for Particle Astrophysics and Cosmology**, *Menlo Park, CA*.

Studied early-universe cosmology, cosmological perturbation theory, and big bang nucleosynthesis.  
Advisors: Roger D. Blandford, Robert V. Wagoner

2004–2007 **University of Southern California**, *Los Angeles, CA*.

Studied perturbative and non-perturbative aspects of type 0 string theory. Proposed how D-branes and fluxes are encoded in the partial differential equations governing these exactly-solvable models.  
Advisor: Clifford V. Johnson

Summer 2006 **Princeton Plasma Physics Laboratory**, *Princeton, NJ*.

Studied ion beam pulses traversing a plasma in the presence of background magnetic fields.  
Advisor: Igor D. Kaganovich

## Publications

- J. Pennington, R. Socher, C. Manning. "GloVe: Global Vectors for Word Representation," in *Proceedings of the 2014 Conference on Empirical Methods in Natural Language Processing*, in press.
- L. J. Dixon, J. M. Drummond, C. Duhr, M. von Hippel and J. Pennington, "Bootstrapping six-gluon scattering in planar  $\mathcal{N} = 4$  super-Yang-Mills theory," arXiv:1407.4724 [hep-th].
- L. J. Dixon, J. M. Drummond, C. Duhr and J. Pennington, "The four-loop remainder function and multi-Regge behavior at NNLLA in planar  $\mathcal{N} = 4$  super-Yang-Mills theory," *JHEP* **1406**, 116 (2014), arXiv:1402.3300 [hep-th].
- V. Del Duca, L. J. Dixon, C. Duhr and J. Pennington, "The BFKL equation, Mueller-Navelet jets and single-valued harmonic polylogarithms," *JHEP* **1402**, 086 (2014), arXiv:1309.6647 [hep-th, hep-ph].
- L. J. Dixon, J. M. Drummond, M. von Hippel and J. Pennington, "Hexagon functions and the three-loop remainder function," *JHEP* **1312**, 049 (2013), arXiv:1308.2276 [hep-th].
- J. Drummond, C. Duhr, B. Eden, P. Heslop, J. Pennington and V. A. Smirnov, "Leading singularities and off-shell conformal integrals," arXiv:1303.6909 [hep-th].
- J. Pennington, "The six-point remainder function to all loop orders in the multi-Regge limit," *JHEP* **1301**, 059 (2013), arXiv:1209.5357 [hep-th].
- L. J. Dixon, C. Duhr, and J. Pennington, "Single-valued harmonic polylogarithms and the multi-Regge limit," *JHEP* **1210**, 074 (2012), arXiv:1207.0186 [hep-th].
- R. Socher, J. Pennington, E. H. Huang, A. Y. Ng, and C. D. Manning, "Semi-supervised recursive autoencoders for predicting sentiment distributions," in *Proceedings of the 2011 Conference on Empirical Methods in Natural Language Processing*, pp. 151–161.
- R. Socher, E. H. Huang, J. Pennington, A. Y. Ng, and C. D. Manning, "Dynamic pooling and unfolding recursive autoencoders for paraphrase detection," in *Advances in Neural Information Processing Systems 24*, J. Shawe-Taylor, R. Zemel, P. Bartlett, F. Pereira, and K. Weinberger, eds., pp. 801–809. 2011.
- R. Iyer, C. V. Johnson, and J. S. Pennington, "Non-perturbative String Theory from Water Waves," *J.Phys.A* **A44** (2011) 375401, arXiv:1011.6354 [hep-th].
- R. Iyer, C. V. Johnson, and J. S. Pennington, "String Theory and Water Waves," *J.Phys.A* **A44** (2011) 015403, arXiv:1002.1120 [hep-th].
- J. Pennington, I. Kaganovich, A. Sefkow, E. Startsev, and R. Davidson, "Charge and Current Neutralization of an Ion Beam Pulse by Background Plasma in Presence of Applied Magnetic Field and Gas Ionization," *Conf.Proc.* **C070625** (2007) 3675.
- J. E. Carlisle, C. V. Johnson, and J. S. Pennington, "D-branes and fluxes in supersymmetric quantum mechanics," arXiv:hep-th/0511002 [hep-th].
- J. E. Carlisle, C. V. Johnson, and J. S. Pennington, "Backlund transformations, D-branes, and fluxes in minimal type 0 strings," *J.Phys.A* **A40** (2007) 12451–12462, arXiv:hep-th/0501006 [hep-th].

## Awards and Honors

- 2003–2007 **University of Southern California**, *Trustee Scholarship*.  
Full-tuition, merit-based scholarship.
- 2004–2007 **University of Southern California**, *Charles Lick Scholarship*.  
Departmental scholarship for undergraduate research.
- 2006 **Princeton Plasma Physics Laboratory**, *National Undergraduate Fellowship in Plasma Physics*.

## Teaching

- 2013 **Teaching Assistant**, *Stanford University*, Particle Physics.  
Delivered lectures, prepared weekly discussion sections, tutored individuals and groups.
- 2007, 2012 **Teaching Assistant**, *Stanford University*, Modern Physics.  
Led small discussion sections, developed weekly problem worksheets, tutored individuals and groups.
- 2008 **Laboratory Assistant**, *Stanford University*, Mechanics.  
Facilitated weekly laboratory experiments, instructed small groups on laboratory fundamentals.

## Conferences and Workshops

- Spring 2014 **Stanford University**, *Stanford Workshop on Artificial Intelligence and Knowledge*.
- Autumn 2010 **Stanford University Math Research Center**, *Chern-Simons Theory: Applications to Geometry and Physics*.
- Summer 2010 **SLAC National Laboratory Center**, *XXXVIII SLAC Summer Institute*, Neutrinos: Nature's Mysterious Messengers.
- Autumn 2009 **SLAC National Laboratory Center**, *Dark Forces Workshop*.
- Summer 2009 **SLAC National Laboratory Center**, *XXXVII SLAC Summer Institute*, Revolutions on the Horizon: A Decade of New Experiments.
- June 2009 **University of California, Santa Cruz**, *Confronting Challenges in Theoretical Physics*.
- Summer 2008 **Stanford Linear Accelerator Center**, *XXXVI SLAC Summer Institute*, Cosmic Accelerators.
- Autumn 2008 **University of California, Los Angeles**, *West Coast LHC Theory Meeting*.
- Spring 2008 **Kavli Institute for Particle Astrophysics and Cosmology**, *The Canadian Institute for Advanced Research's Annual Cosmology and Gravity Program Meeting*.
- Autumn 2006 **University of Southern California**, *Southern California Strings Seminar*.

## Seminars

- Jul. 2014 **IBM Watson**, *Seminar*.
- Jul. 2014 **Google Research**, *Tech Talk*.
- Jun. 2014 **Yahoo! Labs**, *Seminar*.
- Jun. 2013 **SLAC National Accelerator Laboratory**, *Theory Seminar*.
- Nov. 2012 **ETH Zurich**, *Particle Physics Seminar*.
- Jan. 2012 **SLAC National Accelerator Laboratory**, *Theory Seminar*.