YIKAI TENG

Personal homepage: yikaiteng.net
Kölnstraße 502, Room 24, Bonn, Germany, 53117
(+49)0176 8067 7634 ⋄ s6yiteng@uni-bonn.de

EDUCATION

Rheinische Friedrich-Wilhelms-Universität Bonn, Germany
M.S. Mathematics *October 2021 - Present*

University of Illinois at Urbana-Champaign, USA
B.S. Mathematics, Minor in Computer Science *August 2018 - May 2021*
Magna Cum Laude
Highest Distinction in Mathematics GPA: 3.96 out of 4.0

ACADEMIC INTERESTS

I am currently interested in Geometric Topology, in particular 4-manifolds and knot theory.

MASTER'S THESIS

Slice Knots and Exotic 4-manifolds *June 2022 - Present*
Master Thesis, Under Dr. Arunima Ray, University of Bonn.

- Study the theories behind knot concordance and slice knots, including various concordance invariants involving classical knot theory, Khovanov homology theory, Seiberg-Witten Theory and Heegaard Floer Theory.
- Study various constructions of exotic 4-manifolds, including constructions involving corks (corks, anticorks, protocorks), constructions originating in elliptic surfaces (log-transform, knot surgery, ...) along with their influence on Seiberg-Witten invariants, and constructions involving knot traces and the sliceness of knots.
- Study the relations between the above mentioned two branches and possibly to other branches of topology.
- By fixing 12 equivalence relations (and their counterparts relative to boundary) for 4-manifolds with non-trivial boundary, I compare the behaviours to those of the closed manifolds case, and study the relations between these equivalence relations, trying to survey existing and construct new counterexamples.
- Proved the existence and found an example of a knot trace behaving as infinite order plugs.

TEACHING EXPERIENCES

Course Aide: Numerical Methods *August 2019 - May 2021*
With Professor Mariana Silva, U of I.

- Teach theory behind numerical methods and help around 400 students in this Python-based course.
- Assist the professor with in-class activities and help develop and revise homework assignments.
- Host weekly office hours, aid around 20 students with their academic problems.
- Help create and revise online notes for numerical methods and build class website.

SEMINAR TALKS

Zero-Surgeries and Exotic Four-Spheres *May 2022*

- In the seminar on Low Dimensional Topology held by Professor Clifford Taubes, Harvard University.

Conway Knot is not Slice *May 2022*

- In the seminar course: In Memorial of John H. Conway in University of Bonn.

Connections in Principal Bundles *May 2022*
Under Professor Ursula Hamenstädt, University of Bonn.
• In the seminar course: Chern-Weil Theory in University of Bonn.

Connections and Curvatures *December 2021 - January 2022*
Under Professor Daniel Huybrechts, University of Bonn.
• In the seminar course: Complex Geometry and Hodge Theory in University of Bonn.

Holomorphic Quadratic Differentials *December 2021*
Under Professor Ursula Hamenstädt, University of Bonn.
• In the seminar course: Geometry of Teichmüller Spaces in University of Bonn.

Stiefel-Whitney Classes *October 2021*
Under Professor Carl-Friedrich Bödigheimer, University of Bonn.
• In the seminar course: Characteristic Classes in University of Bonn.

UNDERGRADUATE RESEARCH PROJECTS

Higher Symmetries in Geometry and Physics *January 2021 - May 2021*
IGL Project, Under Professor Daniel Berwick Evans, U of I.
• Study the theory behind higher category theory, and in particular, we focus on the **Bi** category of Lie groupoids and bibundles.
• Apply this to Lie group actions on Lie groupoids and prove the equivalence between the category of Lie groupoid actions and the category of central extensions.

Pecan: an automated theorem prover *September 2020 - January 2021*
IGL Project, Under Professor Philipp Hieronymi, U of I.
• Study the theory behind this auto theorem prover, namely a Büchi automaton.
• Study the relation between fractals and automatons, and work on the visualization of various fractals given an arbitrary self-similar automaton.
• Presented our result in Joint Mathematical Meeting, 2021.

Polymath REU *June 2020 - October 2020*
Group Research Project, Under Postdoc Cody Stockdale, Clemson University.
• Work on finding a bound for weak-type $(1, 1)$ property for Riesz Transforms.
• Compose a geometric construction for a dimension dependent bound.

Independent Research *January 2020 - August 2020*
Independent Research Project, Under Professor Bruce Reznick, U of I.
• Work on the generalization of Arnold's Cat Map on various dimensions and spaces.
• Focus on the group of measure preserving self maps on arbitrary dimensional tori $\mathbb{T}^n$, and its relation to the mapping class group, $\mathcal{MCG}(\mathbb{T}^n)$.
• Create Mathematica visualizations of generalized Cat Map.

Visualization of Coupon Collector Problem *January 2019 - September 2019*
IGL Project, Under Professor AJ Hildebrand, U of I.
• Study the coupon collector problem and coupon collector randomness test and visualize such problems by Mathematica.
• Simulation accepted by Wolfram demonstration.

EXTRACURRICULA COURSES

Higgs Bundles *January 2022 - June 2022*
Reading Project, Under Professor Steven Bradlow, U of I.
• Study the theories behind Higgs bundles and Non-abelian Hodge Correspondence.

Gauge Theory and 4-Manifolds *August 2020 - January 2022*
Reading Project, Under Professor Steven Bradlow, U of I.
• Study the topology and geometry of 4-manifolds via Donaldson Theory.

Kervaire Invariant Problem and Surgery Theory *January 2021 - August 2021*
Reading Project, Under Professor Jeremiah Heller, U of I.
• Study the concepts and history of Kervaire invariant 1 problem.
• Study basics of surgery theory.

Complex Algebraic Curves *January 2020 - January 2021*
Reading Project, Under Professor Steven Bradlow, U of I.
• Study the foundation and properties of complex algebraic curves, both algebraically and topologically, including Bézout's Theorem, the degree-genus formula, etc.
• Study complex algebraic curves as Riemann surfaces and related theorems like Abel's Theorem and the Riemann-Roch Theorem.

Morse Theory and Floer Homology *August 2020 - December 2020*
Reading Project, Under Professor Rui Loja Fernandes, U of I.
• Study Morse Theory in a Algebraic Topology perspective, learning distinctive homologies like Morse Homology and Floer Homology.
• Study basics of Floer Homology and gradually march to the field of Symplectic Geometry.

Complex Analysis in a Geometric Approach *August 2019 - December 2019*
Reading Project, Under Professor Richard Laugesen, U of I.
• Apply classical Complex analysis in geometry to study particular metrics like Poincare, Caratheódory, and Kobayashi metric.
• Compare the geometry in complex analysis with classical differential geometry to study the cross sections of the two fields.
• Study harmonic mappings in the complex domain and its application to minimal surface theory.

Modern Theory of Dynamical Systems *August 2019 - December 2019*
Reading Project, Under Professor Eduard-Wilhelm Kirr, U of I
• Study advanced modern theory of dynamical systems, particularly the behavior around a hyperbolic fixed point, like the Hadamard-Perron Theorem and the Hartman-Grobman Theorem.
• Conduct the proof of the existence of the Lake of Wada as a group of four.

ADDITIONAL ACTIVITIES

Mathematical Contest for Modelling *February 2020*
• Construct a math model to predict where Scottish herring will migrate for the next few decades and provide suggestions for fishing companies in Scotland.

Mechmania *Septempber 2019*
• Develop a strategy of a board game to compete with other contestants.

HackIllinois *February 2019*
• Compose tests for LinearMappings package for Julia and add support for Quaternion Numbers.
• Compose various tests and make multiple contributions to the DoubleFloat package for Julia.

ADDITIONAL SKILLS

Coding Skills
• Proficient in various programming languages, including C, C++, Java, Python, Matlab, Mathematica, R, Html.
• Have experience in algorithm development, app developing, web design, etc.

REFERENCES

Arunima Ray *Lise Meitner research group leader*
Max-Planck-Institut für Mathematik.
aruray@mpim-bonn.mpg.de

Steven Bradlow *Professor*
Department of Mathematics, University of Illinois at Urbana-Champaign.
(217) 265-0299, bradlow@illinois.edu

Richard Laugesen *Professor*
Department of Mathematics, University of Illinois at Urbana-Champaign.
(217) 333-1329, laugesen@illinois.edu

Last modified on January 13, 2023