Anand Deopurkar

Contact Information

3 Ames Street
East Campus, W109
Cambridge, MA 02139

Phone: (617)-276-6918
E-mail: anandrd@mit.edu

Education

Jnana Prabodhini Prashala, Pune (India)
5th–10th grade
June 1996–April 2002

Sir Parashurambhau College, Pune (India)
11th–12th grade
June 2002–April 2004

Massachusetts Institute of Technology, Cambridge (MA)
Bachelor of Science (S.B.) in Mathematics
September 2004–date

Current GPA 5.0/5.0

Coursework at MIT

Mathematics

Algebra and Algebraic Geometry		
Algebra I (18.701)	Johan de Jong	A+
Algebra II (18.702)	Johan de Jong	A+
Commutative Algebra (18.705)	Steven Kleiman	A+
Algebraic Geometry I (18.725)	Ilya Tyomkin	A+
Algebraic Geometry II (18.726)	Izzet Coskun	A
Seminar in Algebra (18.704)	Steven Kleiman	A+
Analysis		
Analysis I (18.100B)	Pavel Etingof	A+
Functions of a Complex Variable (18.112)	Sigurdur Helgason	A+
Measure and Integration (18.125)	Nam-Gyu Kang	A+
Differential Analysis I (18.155)	Katrin Wehrheim	A+
Topology		
Introduction to Topology (18.901)	George Lusztig	A+
Algebraic Topology I (18.905)	Olga Plamenevskaya	A
Algebraic Topology II (18.906)	Mark Behrens	A+
Geometry		
Geometry of Manifolds (18.965)	Victor Guillemin	A+
Riemann Surfaces (18.116)	Matthew Hedden	A
Lie Groups (18.755)	Sigurdur Helgason	A+
Other		
Seminar in problem solving (18.S34)	Hartley Rogers, Richard Stanley	-
Laboratory in Mathematics (18.821)	David Vogan	A

Computer Science

Introduction to Algorithms (6.046)	Erik Demaine, Charles Leiserson	A+

Theory of Computation (18.404)	Michael Sipser	A
Lab in Software Eng. (6.170)	Saman Amarasinghe, Michael Ernst	A
Artificial Intelligence (6.034)	Patrick Winston	A
Computation Structures (6.004)	Steve Ward, Srini Devadas	A
Structure and Interpretation of Computer Programs (6.001)	Eric Grimson	A+

Physics

Quantum Physics I (8.04)	Vladan Vuletic	A+
Special Relativity (8.20)	Bruce Knuteson	A+

Awards and Honors

1. Nominated by MIT for membership in the Mathematical Association of America. (2007)
2. Best game and user interface award for the team project on Anti-chess in 6.170. (2007)
   (Fifteen teams of 3-4 students wrote programs to play Anti-chess. Awards were given for the best game and user interface, best design and best artificial intelligence.)
3. Rogers family prize for the research done in Summer Program in Undergraduate Research. (2006)
   (Nine students from MIT interested in mathematical research participated in this program. Awards were given to two students, based on their paper and oral presentation.)
4. Honorable Mention, 66th and 65th William Lowell Putnam Competition. (2006 and 2005)
5. Silver medal, 45th International Math Olympiad, Athens, Greece. (2004)
6. Bronze medal, 44th International Math Olympiad, Tokyo, Japan. (2003)
7. First rank in the Indian National Mathematical Olympiad (INMO). (2003)
   (INMO is the Indian equivalent of USAMO. About 500 students are selected through the Regional Mathematical Olympiad to appear for INMO. Roughly 20,000 students appear for the Regional Mathematical Olympiad from all over India.)
8. Best project award (Physics category) at the Intel Science Talent Discovery Fair, held at the Indian Institute of Technology, Mumbai, India. (2003)
9. Recipient of the National Talent Search scholarship, Govt. of India. (2002)
   (About 750 scholarships are awarded after two rounds of examinations and one interview. Roughly 100,000 high school students from all over India appear for the first round of examinations.)

Undergraduate Research

Undergraduate Research Opportunities Program (2007), MIT

Faculty Adviser: Prof. Steven Kleiman

I worked on a problem related to the principle of specialization of integral dependence, which originates from the problem of describing equisingularity in analytic families. This problem can be phrased in algebraic terms as a question about integral dependence. Consider a family of germs of complex analytical spaces $X \to Y$ such that for each $y \in Y$, the fiber $X(y)$ is equidimensional. Let $E = O_X^p$ be a free module on X and $M \subset E$ a submodule. The goal is to associate a number $e(y)$ to the pair $(M(y), E(y))$, whose constancy in y would ensure the following: If a section h of E is such that its image in $E(y)$ is integrally dependent on $M(y)$ for all y in a Zariski open subset of Y, then h is integrally dependent on M. Observe that if $\operatorname{supp}(E/M) \to Y$ is finite then $M(y) \subset E(y)$ is of finite colength. In this case, Kleiman and Gaffney successfully used the Buchsbaum–Rim multiplicity to construct $e(y)$. For the general case, we needed to find a suitable multiplicity for the pair (N, F) of a free module F and a submodule $N \subset F$. Kleiman and Gaffney's proof indicated that such a multiplicity $\mu(N, F)$ would satisfy certain desirable conditions:

1. $y \mapsto \mu(M(y), E(y))$ is upper semicontinuous on Y,
2. if $N_1 \subset N_2 \subset F$ then $\mu(N_1, F) = \mu(N_2, F)$ if and only if N_2 is integrally dependent over N_1.

A possible candidate for such a multiplicity is the j^* multiplicity of Ulrich and Validashti. Although j^* satisfies (2), it does not give an upper semicontinuous map as in (1). To have something that satisfied (1) and (2), we needed a more general version of j^*, which I aimed to find.

Ulrich and Validashti define the j^* multiplicity for Rees algebras and Rees modules associated to a standard graded algebra over a noetherian local ring. They prove that this multiplicity gives a criterion for integral dependence, leading to (2). I tried to generalize their work to arbitrary finitely generated algebras over noetherian semilocal rings and prove a multiplicity based criterion for integral dependence. I proved that the general version of the j^* multiplicity is equal for integrally dependent algebras. However, I did not succeed in proving that equality of the multiplicities implies integral dependence. Similarly, the question of the upper semicontinuity of the resulting multiplicity is still unsettled.

Summer Program in Undergraduate Research (2006), MIT

Graduate mentor: Xiaoguang Ma (student of Prof. Pavel Etingof)

Given a compact, connected Lie group G, we sought the characteristic classes of principal G bundles over smooth manifolds using Chern–Weil theory.

Let $P \to M$ be a principal G bundle and Ω a curvature form on P arising from a connection. Denote by $\mathfrak{g}$ the Lie algebra of G, by $S(\mathfrak{g})$ the polynomial ring over $\mathfrak{g}$ and by $S(\mathfrak{g})^G$ the ring of polynomials invariant under the adjoint action of G on $\mathfrak{g}$. We began by studying the Chern–Weil homomorphism, which naturally maps $S(\mathfrak{g})^G$ to the cohomology ring $H^*(M)$ using the curvature form Ω. It turns out that the homomorphism is independent of Ω. Denoting this homomorphism by W_P, we see that an element $q \in S(\mathfrak{g})^G$ gives a characteristic class c_q sending $P \mapsto W_P(q)$. Surprisingly, all the characteristic classes of principal G bundles arise in this way. Furthermore, if $T \subset G$ is a maximal torus with Lie algebra $\mathfrak{t}$, then the ring $S(\mathfrak{g})^G$ is isomorphic to the ring $S(\mathfrak{t})^{W(G)}$ of the polynomials on $\mathfrak{t}$ invariant under the action of the Weyl group $W(G)$ of G. Thus, the seemingly daunting problem of finding all characteristic classes of principal G-bundles is reduced to the algebraic problem of computing the ring $S(\mathfrak{t})^{W(G)}$, which is the ring of polynomials invariant under the action of a finite reflection group. We computed this ring for the exceptional Lie groups G_2 and F_4, and looked at some of the implications of these results to reduction problems involving G_2.

Work Experience Head Lab Assistant for Structure and Interpretation of Computer Programs (6.001), Fall 2006. Duties involved hiring and supervising lab assistants, organizing quiz reviews, administrating the computer lab etc.

Programming Languages Scheme, Java, Haskell, C, BASIC

Matlab, Singular, Maple

Languages English, Marathi, Hindi, Lojban