

Preface

The present special volume of *Pure and Applied Mathematics Quarterly* is dedicated to the memory of Professor Bertram Kostant. Kostant was born in Brooklyn, New York in May, 1928 and died in Boston, Massachusetts in February, 2017. After graduating from Stuyvesant High School in 1945, he joined Purdue University as an undergraduate from where he obtained his Bachelor's degree in 1950. He earned his Ph.D. in mathematics under the supervision of Irving Segal from the University of Chicago in 1954. He began his academic career as an Assistant Professor in 1956 at the University of California, Berkeley and rose to full professor there in 1962. But, shortly afterwards he joined the faculty at MIT, where he remained until his retirement in 1993.

Kostant was elected to the National Academy of Sciences U.S.A. in 1978 and has received many other honours and prizes, including election as a Sackler Institute Fellow at Tel-Aviv University in 1982, a medal from the Collège de France in 1983, the Steele prize of the American Mathematical Society in 1990 for his paper: 'On the existence and irreducibility of certain series of representations', Wigner Medal in 2016 and several honorary doctorates. He was an invited speaker at the Nice ICM in 1970, where he gave a talk on 'Orbits and Quantization Theory'. In 2012 he became a Fellow of the American Mathematical Society (during the inaugural class of Fellows).

He directed more than twenty Ph.D. students including Sam Evens, James Lepowsky, Stephen Rallis, James Simons, Birgit Speh, Moss Sweedler, and David Vogan.

Kostant was a pioneer in Lie theory in its various manifestations in the second half of the twentieth century. His mathematical works spanned well over fifty years with more than 100 published papers, several of them being foundational papers spawning tremendous activities in the field. To mention a few: his work on weight multiplicities culminating in the well known *Kostant partition function*; his work on three dimensional subalgebras of semisimple Lie algebras and its connection with the Betti numbers of the corresponding Lie group; his work on the harmonic polynomials giving rise to a separation of variables result (extended to symmetric spaces with Rallis) and a precise description of the affine coordinate ring of the nilpotent cone; his fundamental work on the Lie algebra cohomology of some nilpotent Lie algebras and its connection with the cohomology of partial flag varieties following some works

of Bott and its extension in the works of Kostant and Kumar on the cohomology and equivariant K -theory of partial flag varieties (associated to even Kac-Moody groups) resulting in *Kostant-Kumar nil-Hecke ring*; his elaborate study of the Whittaker modules and the Toda lattice; his fundamental work on Geometric Quantization resulting in *Kostant line bundles*; his work on Convexity Theorem later generalized by Atiyah-Bott and Guillemin-Sternberg; his introduction of *Kostant integral form* of the enveloping algebra which is crucial to the modular representation theory and applications of quantum groups to modular representation theory developed by Lusztig and others; he laid a foundation of super manifolds and super Lie groups and proved a basic structure theorem for its enveloping algebra; his work with Hochschild and Rosenberg on the differential forms on smooth affine varieties; his work with Wallach on Gelfand-Zeitlin theory; his work on Toda lattice and quantum cohomology of flag varieties; his introduction of the cubic Dirac operator following some conjectures of Vogan; and his work on abelian ideals in the nil-radical of a Borel subalgebra. This is only a representative list of some of his fundamental contributions.

We would like to thank all the people who have contributed to the success of this special volume. Kostant's wide interests in mathematics are reflected in the diversity of the contributions in this volume.

Lizhen Ji,
Shrawan Kumar, and
Kefeng Liu

