

COURSE OUTLINE – subject to changes :

L-1	Mon	13	Jan	welcome to mcs 563 – Newton’s method and Bézout’s theorem
L-2	Wed	15	Jan	elimination methods – computing resultants
L-3	Fri	17	Jan	polynomial homotopies and path tracking methods
	Mon	20	Jan	Martin Luther King, Jr., Day. No classes.
L-4	Wed	22	Jan	the division algorithm – rewriting polynomials
L-5	Fri	24	Jan	alpha theory to certify roots – complexity issues
L-6	Mon	27	Jan	computing Gröbner bases with Buchberger’s algorithm
L-7	Wed	29	Jan	multihomogenization – linear product structures – symmetry
L-8	Fri	31	Jan	quotient rings – the shape lemma – zeroes and eigenvalues
L-9	Mon	3	Feb	condition and scaling with applications to chemistry
L-10	Wed	5	Feb	Gröbner basis conversion with the FGLM algorithm
L-11	Fri	7	Feb	cheater’s homotopy – coefficient-parameter continuation
L-12	Mon	10	Feb	rational univariate and Kronecker representation
L-13	Wed	12	Feb	computing turning points defined by real homotopies
L-14	Fri	14	Feb	Border bases and numerically stable normal forms

Project One due on Monday 17 February by 2PM

L-15	Mon	17	Feb	the Newton-Puiseux method for power series solutions
L-16	Wed	19	Feb	Newton polytopes and Kushnirenko’s theorem
L-17	Fri	21	Feb	the Cayley trick – mixed volumes – Bernstein first theorem
L-18	Mon	24	Feb	Bernstein’s 2nd theorem – general Richardson extrapolation
L-19	Wed	26	Feb	polyhedral homotopies to solve sparse polynomial systems
L-20	Fri	28	Feb	review of the first 19 lectures
L-21	Mon	3	Mar	midterm exam (in class or take home)
L-22	Wed	5	Mar	multiple roots – approximate greatest common divisors
L-23	Fri	7	Mar	localization and standard bases
L-24	Mon	10	Mar	Newton’s method with deflation for isolated singularities
L-25	Wed	12	Mar	duality and multiplicity – algorithmic differentiation
L-26	Fri	14	Mar	numerical algebraic geometry – witness sets
L-27	Mon	17	Mar	lifting fibers in a geometric resolution
L-28	Wed	19	Mar	absolute factorization of multivariate polynomials
L-29	Fri	21	Mar	sparse interpolation techniques

Project Two due on Monday 31 March by 2PM

L-30	Mon	31	Mar	approximate factorization of multivariate polynomials
L-31	Wed	2	Apr	Schubert calculus – homotopies for enumerative geometry
L-32	Fri	4	Apr	sum of squares – computations in real algebraic geometry
L-33	Mon	7	Apr	manipulation of ideals
L-34	Wed	9	Apr	binomial ideals
L-35	Fri	11	Apr	primary decomposition
L-36	Mon	14	Apr	Hilbert polynomials
L-37	Wed	16	Apr	diagonal homotopies to intersect algebraic sets
L-38	Fri	18	Apr	computing primary decompositions
L-39	Mon	21	Apr	tropical algebraic geometry
L-40	Wed	23	Apr	convex algebraic geometry
L-41	Fri	25	Apr	algebraic statistics
L-42	Mon	28	Apr	presentation of projects or review for final exam
L-43	Wed	30	Apr	presentation of projects or review for final exam
L-44	Fri	2	May	presentation of projects or review for final exam

Wednesday 7 May, 1:00PM-3:00PM, final examination, room to be announced.