

**COURSE OUTLINE** – subject to changes :

L-1	Mon	10	Jan	introduction – Newton’s method and the theorem of Bézout
L-2	Wed	12	Jan	elimination methods – computing resultants
L-3	Fri	14	Jan	homotopies and path tracking with predictor-corrector methods
	Mon	17	Jan	<b>Martin Luther King Day – no classes</b>
L-4	Wed	19	Jan	the division algorithm – rewriting polynomials
L-5	Fri	21	Jan	alpha theory to certify roots – complexity of Bézout’s theorem
L-6	Mon	24	Jan	computing Gröbner bases with Buchberger’s algorithm
L-7	Wed	26	Jan	multihomogenization – algorithmic differentiation
L-8	Fri	28	Jan	quotient rings – the shape lemma – zeroes and eigenvalues
L-9	Mon	31	Jan	linear product structures and the exploitation of symmetry
L-10	Wed	2	Feb	Gröbner basis conversion with the FGLM algorithm
L-11	Fri	4	Feb	the cheater homotopy – coefficient-parameter continuation
L-12	Mon	7	Feb	rational univariate representation
L-13	Wed	9	Feb	condition and scaling with applications to chemistry
L-14	Fri	11	Feb	the Kronecker parameterization

**Project One due on Monday 14 February by 11AM**

L-15	Mon	14	Feb	computing turning points defined by real homotopies
L-16	Wed	16	Feb	Newton polytopes and Koushnirenko’s theorem
L-17	Fri	18	Feb	the Cayley trick – mixed volumes – Bernshtein’s first theorem
L-18	Mon	21	Feb	Bernshtein’s second theorem – Puiseux series
L-19	Wed	23	Feb	polyhedral homotopies to solve sparse polynomial systems
R-1	Fri	25	Feb	review of the first 19 lectures
E-1	Mon	28	Feb	<b>midterm exam – either in class or take home</b>
L-20	Wed	2	Mar	multiple roots – approximate greatest common divisors
L-21	Fri	4	Mar	localization and standard bases
L-22	Mon	7	Mar	Newton’s method with deflation for isolated singularities
L-23	Wed	9	Mar	duality and multiplicity structure
L-24	Fri	11	Mar	numerical algebraic geometry – witness sets
L-25	Mon	14	Mar	lifting fibers in a geometric resolution
L-26	Wed	16	Mar	absolute factorization of multivariate polynomials
L-27	Fri	18	Mar	sparse interpolation techniques
L-28	Mon	28	Mar	approximate factorization of multivariate polynomials
L-29	Wed	30	Mar	numerical Schubert calculus – homotopies for enumerative geometry
L-30	Fri	1	Apr	sum of squares

**Project Two due on Monday 4 April by 11AM**

L-31	Mon	4	Apr	primary decomposition
L-32	Wed	6	Apr	saturation and splitting
L-33	Fri	8	Apr	equidimensional primary decompositions
L-34	Mon	11	Apr	computing primary decompositions
L-35	Wed	13	Apr	diagonal homotopies to intersect algebraic sets
L-36	Fri	15	Apr	border bases
L-37	Mon	18	Apr	tropical algebraic geometry
L-38	Wed	20	Apr	algebraic statistics
L-39	Fri	22	Apr	convex algebraic geometry
R-2	Mon	25	Apr	presentation of projects or review for final exam
R-3	Wed	27	Apr	presentation of projects or review for final exam
R-4	Fri	29	Apr	presentation of projects or review for final exam

**Friday 6 May, 10:30AM - 12:30PM : Final Examination – room to be announced.**