Survey of Computational Science and Engineering Graduate Programs
Results as of 1/12/12

Below is a summary of the Survey of Computational Science and Engineering Graduate Programs that was conducted during November and December 2011. The full details of the survey can be found at: http://icl.cs.utk.edu/survey/summary/. If you would like to take the survey see: http://icl.cs.utk.edu/survey/.

Thanks again,
Jack Dongarra (University of Tennessee)
Linda Petzold (University of California, Santa Barbara)
Vladimir Voevodin (Moscow State University)

Computational Science and Engineering Survey

- 66 participants started the survey
- Defining Computational Science and Engineering:
  - 41.8% define CSE as mathematical modeling, numerical methods, and high performance computing.
  - 3.6% define CSE as computing that focuses more on the science or engineering outcome than on the computational methodology.
  - 54.5% defined CSE as falling into both of the above categories.

Graduate Programs

- 59 (89%) of participants have a graduate CSE program
- 55 (93%) of these programs have websites:

Institution	Website URL
Bogazici University, Istanbul	http://www.cse.boun.edu.tr/
Brockport, State University of New York	http://www.brockport.edu/cps/
California Institute of Technology	http://www.cse.caltech.edu/
Cornell University	http://www.cis.cornell.edu/cse/
EPFL Lausanne	http://cse.epfl.ch/
ETH Zurich, Switzerland	http://www.cse.ethz.ch/
George Mason University	http://cds.gmu.edu/content/phd-computational-sciences-and-informatics/
Georgia Institute of Technology	http://www.cseprograms.gatech.edu/
Harvard	http://iacs.seas.harvard.edu/secondary-field-in-cse/secondary-field-in-cse/

K.U. Leuven	http://www.cs.kuleuven.be/wit/
KTH Royal Institute of Technology Stockholm	http://www.kth.se/en/studies/programmes/em/cosse
Louisiana Tech	http://www.latech.edu/coes/cam/
McMaster University	http://computational.mcmaster.ca/
Michigan Tech	http://www.mtu.edu/gradschool/programs/degrees/computational/
Middle East Technical University	http://www3.iam.metu.edu.tr/iam/index.php/Cryptography
Middle East Technical University	http://www3.iam.metu.edu.tr/iam/index.php/Scientific_Computing
Mississippi State University	http://www.hpc.msstate.edu/education/
MIT	http://web.mit.edu/cdo-program/
Moscow State University	http://www.srcc.msu.ru/nivc/index_engl.htm
National Institute of Technology Calicut	http://nitc.ac.in/
National University of Ireland, Galway	http://www.nuigalway.ie/courses/research-postgraduate-programmes/structured-phd/physics.html
New York University	http://math.nyu.edu/degree/ms/scicomputing.html
Penn State	http://www.csci.psu.edu/
Queen Mary University of London	http://www.sems.qmul.ac.uk/pgadmissions/programmes/?computationalaidedengineering
RWTH Aachen University	http://www.aices.rwth-aachen.de/
Second University of Naples	http://www.diam.unina2.it/
Seoul National University	http://cst.snu.ac.kr/
Simon Fraser University	http://www.math.sfu.ca/graduate/prospective_students#apma
Stanford University	http://icme.stanford.edu/
Technical University of Denmark	http://www.dtu.dk/subsites/mmc-master.aspx
Technische Universität Braunschweig	https://www.tu-braunschweig.de/cse/
Technische Universität München	http://www.cse.tum.de/
TU Dortmund	http://www.tu-dortmund.de/uni/Einstieg/studienangebot/kurzinfos/1fach/natur/fk01_technomath_bama/index.html
University of Bristol	http://www.cs.bris.ac.uk/Teaching/Resources/COMS35101/
University of California, Santa Barbara	http://www.cse.ucsb.edu/
University of Colorado at Boulder	http://amath.colorado.edu/cmsms/index.php?page=supplement-to-the-catalog-2011-2012
University of Delaware	http://www.math.udel.edu/CinCSE
University of Dublin, Trinity College	http://www.maths.tcd.ie/hpcmsc/
University of Edinburgh	http://msc.maths.ed.ac.uk/sc/index/
University of Illinois at Urbana-	http://www.cse.illinois.edu/

Champaign	
University of Iowa	http://www.amcs.uiowa.edu/
University of Michigan	http://www-ners.engin.umich.edu/areas/scientificcomputing/
University of New Mexico	http://www.hpc.unm.edu/education/cse-program/
University of Ontario	http://www.science.uoit.ca/graduate/modelling_and_computationalscience/index.php
University of Pennsylvania	http://www.amcs.upenn.edu/
University of Tennessee, Chattanooga	http://www.utc.edu/Research/SimCenter/
University of Tennessee, Knoxville	http://igmcs.utk.edu/
University of Texas at Austin	http://www.ices.utexas.edu/
University of Texas at El Paso	http://academics.utep.edu/Default.aspx?tabid=61122
University of Utah (MS)	http://www.ces.utah.edu/
University of Utah (PhD)	http://www.cs.utah.edu/graduate/scientific/
University of Warwick	http://go.warwick.ac.uk/csc/
University of Waterloo	http://www.math.uwaterloo.ca/navigation/CompMath/
Uppsala University	http://www.it.uu.se/edu/masters/CompSc/
William & Mary	http://www.cs.wm.edu/

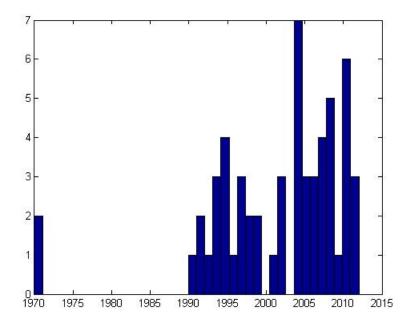- Types of graduate programs:
  - A degree in CSE: 41
  - A minor in CSE: 7
  - A certificate in CSE: 6
  - A track in CSE 2
- Program inception dates:

- Average time to establish graduate program: 2 years

- Student Enrollment and graduation for graduate programs
  - Master's programs
    - Current enrollment: 26.7 mean; 12 median
      - Mean Gender Distribution: 28% female, 72% male
    - Graduates: 275 mean; 23 median
      - Mean Gender Distribution: 29% female, 71% male
  - PhD programs
    - Current Enrollment: 21.7 mean; 10 median
      - Mean Gender Distribution: 25% female, 75% male
    - Graduates: 22.4 mean; 4.5 median
      - Mean Gender Distribution: 28% female, 72% male

- 92.5% of the CSE graduate programs have a core curriculum:

Institution	Curriculum
Bogazici University, Istanbul	8 courses (a Math course, a Numerical Analysis course, 2 area electives, 3 computational electives, 1 computational project), 2 seminar courses, and thesis.
Brockport, State University of New York	Core courses (12 credits): CPS 533 Scientific Visualization (3), CPS 602 Advanced Software Tools (3), CPS 604 Comp Methods in the Physical Sciences (3), CPS 644 Supercomputing and Applications (3). Research experience (6 credits): CPS 699 Independent Study (3), CPS 710 Thesis (3). Electives Credits (12 credits) - Computational-X courses in an area of application: At or above the 500 level (6 credits), At or above the 600 level (6 credits).
College of William and Mary	All requirements of the Computer Science track with the Computational Methods course required. In addition, at least one course from another department (typically physics, applied science, or math).
Cornell University	Three courses taken from a "core list" and breadth list.
EPFL Lausanne	http://cse.epfl.ch/CurrentStudy-plan http://cse.epfl.ch/files/content/sites/cse/files/MA-CO_master2011.pdf
ETH Zurich, Switzerland	Core courses, field of specialization, term paper, electives, master thesis, optionally PhD thesis.
George Mason University	48 hours coursework beyond BS, 24 hours research.
Georgia Institute of Technology	Pick 4 (of 5) core courses, Computation specialization, Application specialization
Harvard University	4 courses: 2 in Applied Math and 2 in Computer Science; each student must take 2 of these in addition to 2 computation-intense electives.
K.U. Leuven	We have 8 obligatory courses. The students complete their program by choosing from a variety of courses, organized under the headings: Industrial Process Control, Data-mining, Image Processing, Scientific Computing and Simulation, Cryptography. The eight core courses are: Numerical simulation of differential equations, System identification and modeling, Optimization, Technical Mathematics, Computer based control techniques, Nonlinear systems, Case studies in mathematical engineering, Technical-Scientific Software. More info with complete list of courses here (site in Dutch only!): http://onderwijsaanbod.kuleuven.be/opleidingen/n/SC_51016867.htm
KTH Royal Institute of Technology Stockholm	The COSSE master's programme is a two-year programme including compulsory mobility for the students. They will enter in one of the universities (the "home university") and continue the second year at one of the other universities in another country (the "host university"). The first 60 ECTS credit points are taken at the home university and the remaining 60 ECTS credit points are taken at the host university. The programme includes three semesters of courses followed by the fourth research semester spent on the Master's Thesis (30 ECTS) under the supervision of both the home and the host university. Compulsory courses: Numerical Analysis, Applied Mathematics, Scientific Computing. Conditionally elective courses: preparation for specialization, specialization courses (compulsory and elective).
Louisiana Tech University	Course work, qualifying and comprehensive exams, dissertation.
McMaster University	Foundations of Modern Scientific Programming, Foundations of Scientific Computing, Advanced Computational Methods and Models

Middle East Technical University	Scientific Computing I & II, Numerical Optimization, Mathematical Modeling, Statistical Learning and Data mining, Inverse Problems, Finite Elements, Applied Nonlinear Dynamics.
Middle East Technical University - Institute of Applied Mathematics / Cryptography program	Core Courses: IAM 501 Introduction to Cryptography (3-0) 3, IAM 502 Stream Ciphers (3-0) 3, IAM 503 Applications of Finite Fields (3-0) 3, IAM 504 Public Key Cryptography (3-0) 3, IAM 512 Block Ciphers (3-0) 3, IAM 589 Term Project (0-2) NC, IAM 590 Graduate Seminar (0-2) NC, IAM 500 M.S. Thesis (Non-credit), and two electives.
MIT	Coursework and Thesis
National Institute of Technology, Calicut, India	Applied and Pure Mathematics Papers.
New York University	Numerical Methods I & II; Fundamental Algorithms; Methods of Applied Math; Programming Languages; Open Source Tools; Computer Graphics; Fluid Dynamics; 2 electives; a master's thesis.
Penn State	See http://www.csci.psu.edu/
Queen Mary, University of London	Mechanics of Continua, Computational Engineering (FEM), C++ Programming, Computational Fluid Dynamics, Research Methods, Numerical Optimisation + specialist graduate level modules from Mech/Aero/Energy/Biomedical Engineering
RWTH Aachen University	M.Sc. 90-120 credits, PhD short courses.
Second University of Naples	Previous courses in Numerical Analysis and PDE.
Seoul National University	Course: Advanced Programming for Scientific Programming, Parallel Scientific Computation, Scientific Computational Modeling, Advanced Matrix Compute Topics in Advance Scientific Computation, Topics in Advance Parallel Computation, Topics in Advanced Computational Modeling.
Simon Fraser University	MSc program requires 7 courses in total. Four courses are chosen from: Advanced Mathematical Methods I, Advanced Mathematical Methods II, Numerical Linear Algebra, Numerical Solution of Partial Differential Equations, Fluid Dynamics, Analysis and Computation of Models. Plus two more graduate courses. Plus one more graduate or undergraduate course. Plus a Master's thesis and oral defense. The PhD program has the same course requirements as the MSc plus two more graduate courses. Plus the PhD thesis and oral defense.
Stanford	6 core courses, 2-3 programming courses, and 9-12 elective courses.
Technical University of Denmark	General competence courses (30 ECTS), Technological specialization courses (30 ECTS), Electives (30 ECTS), Thesis (30 ECTS).
Technische Universitaet Muenchen	Computer Science, Applied Mathematics, Scientific Computing, Application Area (e.g. Computational Mechanics, Computational Fluid Dynamics, Computational Electronics, Algorithms in Scientific Computing, Parallel and Distributed Computing, High Performance Computing).
Technische Universität Braunschweig	Basic Core Courses - ENG: Foundations of Natural and Engineering Sciences; MCS: Foundations of Mathematics and Computer Science. Elective Core Courses - ENG: Computational Methods in Engineering Sciences; MCS: Applied Mathematics and Computer Science. In-Depth-Courses - Specializations Courses, Specialization Project, Seminar Presentation, Master Thesis.

The University of Texas at Austin	Core courses in three areas: Area A is Applicable Mathematics, Area B is numerical Analysis and Scientific Computing, and Area C is Mathematical Modeling and Applications.
The University of Texas at El Paso	2 core courses in computational science, 4 prescribed classes (approved list from science & engineering courses), 7 free elective classes (approved list from science & engineering courses).
Trinity College Dublin	C programming, numerical methods, stochastic methods, high-performance computing software, high-performance computing architecture, software development tools, financial mathematics, monte carlo methods.
TU Dortmund	For MS/BSc: 60% math/computing, 40% engineering (focus within engineering chosen by the students, examples include classical continuum mechanics but also life sciences etc.). For BSc: 60% math includes classical applied math curriculum with opportunities to specialize early, and mandatory computing portions. Highlight: 2-semester-10-student project group covering the entire CSE cycle from engineering problem to mathematical modeling to algorithms/discretisations to implementations (with HPC in mind) to post processing. For MS: advanced topics with only loose rules on what to specialize in/where to stay in general.
University of Bristol	Undergraduates must choose from a number of parallel tracks, one of which is HPC, others including security, data mining and machine learning, embedded systems, microelectronics, etc. Lots of both hardware and software.
University of California Santa Barbara	Numerical Methods: at least 3 courses from a 4-course menu; Parallel Computing: 1 course; Applied Mathematics: a 2-course sequence.
University of California, San Diego	PHD Numerical PDEs, Parallel Computing, An applications course.
University of Colorado, Boulder	For the MS student: Numerical-Analysis (two courses) and 24 additional credits. Students also need to take an out of department sequence where Math is applied.
University of Delaware	15 credits, either non-degree or part of degree; choose 5 courses from a list; a cis algorithms course is required; one of a list of three numerical methods class is required; then three more courses. At least two must be highest level grad class. The courses must be from at least 3 different departments, to make it interdisciplinary.
University of Edinburgh	See the list at: http://msc.maths.ed.ac.uk/sc/study-programme-sc/compulsory-courses-sc
University of Illinois at Urbana-Champaign	Numerical Analysis, Parallel Programming, Scientific Visualization.
University of Iowa	http://www.amcs.uiowa.edu/index.php?cb=program#new_curriculum
University of Michigan	http://www-ners.engin.umich.edu/areas/scientificcomputing/scientificcomputingoption.pdf
University of New Mexico	Several required courses (parallel computing); electives (many options from many departments); computational aspect to the thesis; prerequisites at the undergrad level (math, physics, CS). See: http://www.hpc.unm.edu/education/cse-program
University of Ontario Institute of Technology (UOIT)	Note: our program is stand-alone (its requirements are independent of any other program). Core courses in: 1) Numerical Analysis, 2) Mathematical Modeling, and 3) High Performance Computing, plus 3 elective courses.

University of Pennsylvania	Two semesters of Analysis, Applied Algebra, and Probability and Stochastic processes.
University of Tennessee, Chattanooga	The core curriculum coursework integrates the three areas of CmE: Computational modeling and simulation for engineering analysis and design; applied scientific computing; applied computational mathematics. All student research is integrated with faculty team research, including significant student interaction with multiple CmE faculty members. The program is open to students with a baccalaureate degree in engineering, science, or mathematics.
University of Tennessee, Knoxville	See http://igmcs.utk.edu/requirements/
University of Utah	(1) http://www.ces.utah.edu/course_info.html (2) http://www.cs.utah.edu/graduate/scientific/
University of Warwick	An pre-introductory course on Linux and R. A module on data structures and algorithms (which also teaches a structured approach to code development). A module on OpenMP and MPI. A selection of approved masters-level courses offered by other departments within our Science faculty.
University of Waterloo	6 courses and a 4-month research project (1-year Master's).

- 80% of participants encourage or require multidisciplinary co-advising of PhD or MS theses.
- 9.6% require an internship program for graduate students.
- Resources available in the programs surveyed:
    - 47% have career development workshops
    - 96% have guest speakers
    - 77% have visitors
    - 62% have travel support for students
- 54% of programs are administered as a separate entity
- 46% of programs reside within a department
- 60% of programs receive resources for administrative support
    - 44% of programs provide release time for faculty to administer the program
    - 75% of programs have secretarial support
- 78% of programs have website support, of which:
    - 73% have development support
    - 95% have maintenance support
- 49% of programs have support for graduate students, of which:
    - 28% have CSE fellowships
    - 68% have TA positions
    - 76% have RA positions

- 64% of programs receive computing resources:

Institution	Computing Resources
California Institute of Technology	These kinds of resources are provided by the student's Ph.D. option (major).
College of William and Mary	Access to a computational cluster of a few hundred processors (which was started as part of this program), but currently administered by the University.
EPFL Lausanne	Access to EPFL Cluster for specific courses or projects.
ETH Zurich, Switzerland	Free access to high performance computers.
Georgia Institute of Technology	Campus-wide HPC facilities, CSE computing facilities.
Harvard University	HPC cluster (576 cores); GPGPU cluster (16 CPU nodes + 32 GPUs); 2 workstations; cloud resources. These resources are not dedicated but are available to other SEAS faculty, students, and collaborators. Harvard also provides a shared research computing facility with 13,000+ cores.
K.U. Leuven	PC rooms widely available throughout the city, some dedicated to the departments involved with all relevant scientific software installed. Supercomputing resources also available.
Michigan Technological University	256 core Infiniband interconnected computer.
Middle East Technical University	High performance computational computer systems, laboratories.
National Institute of Technology, Calicut, India	Computational labs, etc.
New York University	The systems administrators at the Courant Institute manage Courant's own (very substantial) computing resources.
Novosibirsk State University	Access to Siberian Supercomputer Center.
RWTH Aachen University	320 core cluster, VR facility, and HPC resources.
Simon Fraser University	Basic computing facilities provided by the university. Computing labs available through the Pacific Institute for the Mathematical Sciences. Supplemental computing resources funded by faculty research grants and NSERC equipment grants. High performance computing resources available through the WestGrid computing consortium.
Stanford	We have a compute cloud, shared memory machines for data-intense computing, and a GPU cluster. Funding comes from the School of Engineering as well as industry (NVIDIA in particular).
Technische Universität Braunschweig	Access to computer facilities of the university, high performance computing.
The University of Texas at Austin	Substantial computing resources are provided through the Institute, including desktops, Linux clusters, a visualization lab, and supercomputer clusters.
The University of Texas at El Paso	ICES CPU time, other advisors have access to supercomputing resources.

Trinity College Dublin	Linux cluster, GPGPU system
TU Dortmund	Usual collection of student computer pools dedicated HPC workstations (GPUs, etc.) access to medium-scale 2000+ core machine if needed for seminar/thesis work.
University of Bristol	Access to the Blue Crystal supercomputer (>400 nodes of quad-core x86, Infiniband interconnect). Also 4 dual GPU nodes (Tesla C2050).
University of Colorado-Boulder	Access to campus network, access to a large parallel processor.
University of Edinburgh	University cluster access and GPU workstations.
University of Illinois at Urbana-Champaign	Access to a computing cluster with 3600 cores.
University of Iowa	Computers in labs and student offices.
University of New Mexico	Provided by CARC free of charge, with support from UNM OVPR. See: http://www.hpc.unm.edu/systems-table
University of Pennsylvania	Workstations for the students, access to larger scale computing if needed.
University of Tennessee, Chattanooga	The SimCenter and its computational engineering program occupy a dedicated 31,000 sq. ft. research and education facility adjacent to the UTC campus. This facility includes faculty offices, student cubicles, a 1,500 sq. ft. computer room, classrooms, conference/meeting room, multimedia auditorium, research library, and other workspace. The SimCenter has a dedicated, in-house designed and operated computing facility consisting of multiple diskless Linux clusters (up to 1,300 cores) and extensive computing infrastructure for data storage, networking, and desktop computers.
University of Tennessee, Knoxville	Access to NSF Kraken system from the University of Tennessee.
University of Warwick	Access to a local cluster (3,000 cores), local cluster of workstations, and desktop Linux workstations.
University of Waterloo	Desktop workstations for students and access to faculty computing resources.

Undergraduate Programs

- 14 (23%) participants have an undergraduate program in CSE
- 13 (93%) of these undergraduate programs have websites:

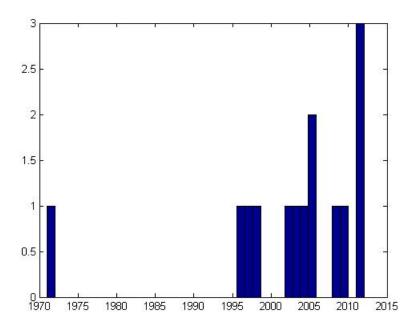| Institution	Website
Brockport, State University of New York	http://www.brockport.edu/cps/
ETH Zurich, Switzerland	http://www.rw.ethz.ch/bachelor/index
George Mason University	http://cds.gmu.edu/content/bs-computational-and-data-sciences/
Illinois State University	http://www.phy.ilstu.edu/programs/computer_physics/
Moscow State University	http://www.srcc.msu.ru/nivc/index_engl.htm
RWTH Aachen University	http://www.ces.rwth-aachen.de/
Seoul National University	http://uipcs.snu.ac.kr/main.php
Stanford	http://mcs.stanford.edu/
Technical University of Denmark	http://www.mat.dtu.dk/English/Education/CivilBachelor.aspx
The University of Texas at Austin	http://www.ices.utexas.edu/programs/cse-certificate/
TU Dortmund	http://www.tu-dortmund.de/uni/Einstieg/studienangebot/kurzinfos/1fach/natur/fk01_technomath_bama/index.html
University of Colorado, Boulder	http://amath.colorado.edu/cmsms/index.php?page=undergraduate-program
University of Waterloo	http://www.math.uwaterloo.ca/navigation/CompMath/

- Types of undergraduate programs:
    - A degree in CSE: 11
    - A minor in CSE: 1
    - A certificate in CSE: 2
    - A track in CSE: 1

- Program inception dates:

- Average time to establish undergraduate program: 2.3 years
- Student Enrollment and graduation for undergraduate programs
  - Undergraduate programs
    - Current enrollment: 70 mean; 40 median
      - Mean Gender Distribution: 24% female, 76% male
    - Graduates: 93 mean; 50 median
      - Mean Gender Distribution: 23% female, 77% male
- 100% of the CSE undergraduate programs have a core curriculum:

Institution	Curriculum
Brockport, State University of New York	Prerequisites (14 Credits) - MTH 201 Calculus I (4), MTH 202 Calculus II (4), MTH 281 Discrete Mathematics (3), CSC 120 Introduction to Computer Science (3). Required Courses (47 credits) – Mathematics courses (13 credits): MTH 203 Calculus III (4), MTH 255 Differential Equations (3), MTH 324 Linear Algebra (3), MTH 346 Probability and Statistics (3); Computer Science Courses (4 credits): CSC 203 Fundamentals of Computer Science I (4); Computational science Courses (24 credits): CPS 201 Computational Tools I (3), CPS 202 Computational Tools II (3), CPS 303 High Performance Computing (3), CPS 333 Scientific Computing (3), CPS 304 Simulation and Modeling (3), CPS 404 Applied and Computational Mathematics I (3), CPS 405 Applied and Computational Mathematics II (3), CPS 433 Scientific Visualization (3); Elective Courses (6 credits).
ETH Zurich, Switzerland	Basic math and natural sciences courses, numerical analysis core courses, field of specialization, electives, BSc thesis.
George Mason University	18 credits in CDS core courses, 1 credit in IT ethics, 7 credits in computer science, 8 credits in physics, 20 credits in mathematics, 3 credits in statistics.
Illinois State University	2 CS courses, 3 dedicated Computational Physics courses, computing in other physics courses.

Louisiana State University	Item 6a at: https://www.math.lsu.edu/ugrad/requirements/. There are four core numerical courses: Numerical Linear Algebra, Numerical Analysis, Numerical Differential Equations, and Numerical Optimization.
RWTH Aachen University	210 credits.
Seoul National University	Understanding Computational Sciences, Capstone Research in Computational Sciences, Theory and Practice in Computational Sciences, History of Computational Sciences, Modeling and Simulation in Computational Sciences, Computational Science Models and Data, Introduction to Scientific Visualization, Computational Social Sciences, Topical Research in Computational Sciences.
Stanford	75 units (approximately 20-25 courses) in math and computing, with enough room left for students to specialize in an application area.
The University of Texas at Austin	18 credit hours coursework and Scientific Computing Project supervised by program faculty.
TU Dortmund	For MS/BSc: 60% math/computing, 40% engineering (focus within engineering chosen by the students, examples include classical continuum mechanics but also life sciences etc.). For BSc: 60% math includes classical applied math curriculum with opportunities to specialize early, and mandatory computing portions. Highlight: 2-semester-10-student project group covering the entire CSE cycle from engineering problem to mathematical modeling to algorithms/discretisations to implementations (with HPC in mind) to post processing. For MS: advanced topics with only loose rules on what to specialize in/where to stay in general.
University of Colorado, Boulder	Regular undergraduate curriculum.
University of Waterloo	Faculty core + 4 computational math core courses + electives (some computational mathematics, some mathematics, some general).

- 15% of programs require an internship for undergraduate students