Computer Science (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Computer Science" without track specifications. Students may request a department letter upon successful completion of a track curriculum.

Master of Computer Science (MR)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select a minimum of three courses from &quot;Core Courses&quot; listed below</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Required Course</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CSC 600</td>
<td>Computer Science Graduate Orientation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electives Courses</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>CSC 500 or 700-level courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electives or Other Restricted Electives</td>
<td></td>
<td>9</td>
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</tr>
<tr>
<td>Electives</td>
<td>Take any combination of 500- or 700-level courses in Computer Science, the College of Engineering or the College of Sciences</td>
<td></td>
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</tr>
<tr>
<td>Total Hours</td>
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</table>

Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
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</thead>
<tbody>
<tr>
<td>Select a minimum of three courses: one from either category with two from the remaining category</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theory</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>CSC 503</td>
<td>Computational Logic</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 505</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 512</td>
<td>Compiler Construction</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 514</td>
<td>Foundations of Cryptography</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 565</td>
<td>Graph Theory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 579</td>
<td>Introduction to Computer Performance Modeling</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 580</td>
<td>Numerical Analysis I</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Systems Category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 707</td>
<td>Automata, Languages and Computability Theory</td>
<td>3</td>
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</table>

Master of Computer Science (MR) with Data Science Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
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<tbody>
<tr>
<td>Required Courses</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics in Computer Science (Foundations of Data Science)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 600</td>
<td>Computer Science Graduate Orientation</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Data Science</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Any two courses from the &quot;Algorithmics&quot; Category listed below</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Science Electives</td>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Select three courses from at least two categories listed below</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Science Core Courses, Graduate Electives or Restricted Electives</td>
<td>12</td>
<td></td>
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</table>
Take any combination from the available categories listed below

| Total Hours | 31 |

### Algorithmics Category

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>CSC 505</td>
<td>Design and Analysis Of Algorithms</td>
<td>3</td>
<td>3</td>
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<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I</td>
<td>3</td>
<td></td>
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<tr>
<td>CSC 522</td>
<td>Automated Learning and Data Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 720</td>
<td>Artificial Intelligence II</td>
<td>3</td>
<td></td>
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<tr>
<td>CSC 722</td>
<td>Advanced Topics in Machine Learning</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Topics include: Graph Data Mining; Spatial and Temporal Data Mining; Machine Learning for User Adaption; Advanced Algorithms; Algorithms for Data Guided Business Intelligence)</td>
<td>1-6</td>
<td>1-6</td>
</tr>
<tr>
<td>CSC 791</td>
<td>Advanced Topics In Computer Science (Topics include: Graph Data Mining; Spatial and Temporal Data Mining; Machine Learning for User Adaption; Advanced Algorithms; Algorithms for Data Guided Business Intelligence)</td>
<td>1-6</td>
<td>1-6</td>
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</tbody>
</table>

### Systems Category

<table>
<thead>
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<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CSC 540</td>
<td>Database Management concepts and Systems</td>
<td>3</td>
<td>3</td>
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<tr>
<td>CSC 541</td>
<td>Advanced Data Structures</td>
<td>3</td>
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<tr>
<td>CSC 547</td>
<td>Cloud Computing Technology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 548</td>
<td>Parallel Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science</td>
<td>1-6</td>
<td>1-6</td>
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<tr>
<td>CSC 724</td>
<td>Advanced Distributed Systems</td>
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<tr>
<td>CSC 742</td>
<td>Advanced Topics in Database Management Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 750</td>
<td>Service-Oriented Computing</td>
<td>3</td>
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</table>

### Applications Category

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<th>Counts towards</th>
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<tbody>
<tr>
<td>CSC 530</td>
<td>Computational Methods for Molecular Biology</td>
<td>3</td>
<td></td>
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<tr>
<td>CSC 554</td>
<td>Human-Computer Interaction</td>
<td>3</td>
<td></td>
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<tr>
<td>CSC 555</td>
<td>Social Computing and Decentralized Artificial Intelligence</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 561</td>
<td>Principles of Computer Graphics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science (Topics include: Spoken Dialogue Systems; Intelligent Game Learning; Educational Data Mining)</td>
<td>1-6</td>
<td>1-6</td>
</tr>
</tbody>
</table>
**Master of Computer Science (MR) with Security Track**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Required Courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Security Core Courses</strong></td>
<td>9</td>
<td></td>
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<tr>
<td></td>
<td>Select three courses from “Security Core Courses” listed below</td>
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</tr>
<tr>
<td></td>
<td><strong>Security Foundations Courses</strong></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select three courses from at least two categories under “Security Foundations Courses” listed below</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Computer Science Core Courses, Graduate Electives or Restricted Electives</strong></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take any combination from the available categories listed below</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

### Security Core Courses

Select three of the following courses:

- **CSC 514** Foundations of Cryptography  
- **CSC 515** Software Security  
- **CSC 705** Operating Systems Security  
- **CSC 774** Advanced Network Security  
- **CSC 533** Privacy in the Digital Age  
- **CSC 591** Special Topics In Computer Science (Specifically: Systems Attacks and Defenses)  

### Security Foundation Courses

Select three courses from at least two categories below:

- Systems Foundations
- Theory Foundations
- Privacy Foundations
- Operating Systems Principles
- Software Engineering
- Database Management concepts and Systems
- Parallel Systems
- Computer Networks
- Internet Protocols
- Introduction to Wireless Networking
- Software Testing and Reliability
- Advanced Distributed Systems
- Design and Analysis Of Algorithms
- Compiler Construction
- Advanced Data Structures
- Graph Theory
- Automata, Languages and Computability Theory
- Advanced Topics in Machine Learning
- Automated Learning and Data Analysis
- Human-Computer Interaction
- Social Computing and Decentralized Artificial Intelligence
- Special Topics In Computer Science (Specifically: Foundations of Data Science)
## Master of Computer Science (MR) with Software Engineering Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
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</thead>
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<tr>
<td></td>
<td><strong>Required Courses</strong></td>
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<td></td>
</tr>
<tr>
<td>CSC 510</td>
<td>Software Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 600</td>
<td>Computer Science Graduate Orientation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Software Science Courses</strong></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select three courses from &quot;Software Science Courses&quot; listed below</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Software Foundations Courses</strong></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select two courses from &quot;Software Foundations Courses&quot; listed below</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Computer Science Core Courses, Graduate Electives or Restricted Electives</strong></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take any combination from the available categories listed below</td>
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<tr>
<td></td>
<td><strong>Thesis Research Projects</strong></td>
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<tr>
<td></td>
<td>Thesis Research Project opportunities will be communicated by faculty</td>
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</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
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</table>

### Software Science Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Select three courses from the following:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 515</td>
<td>Software Security</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 519</td>
<td>DevOps: Modern Software Engineering Practices</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 591</td>
<td>Special Topics In Computer Science</td>
<td>1-6</td>
<td></td>
</tr>
<tr>
<td>CSC 710</td>
<td>Software Engineering as a Human Activity</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 712</td>
<td>Software Testing and Reliability</td>
<td>3</td>
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</tbody>
</table>

### Software Foundations

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Select two courses from the following:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 503</td>
<td>Computational Applied Logic</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 512</td>
<td>Compiler Construction</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 517</td>
<td>Object-Oriented Design and Development</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 520</td>
<td>Artificial Intelligence I</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 522</td>
<td>Automated Learning and Data Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 540</td>
<td>Database Management concepts and Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 547</td>
<td>Cloud Computing Technology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 554</td>
<td>Human-Computer Interaction</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSC 750</td>
<td>Service-Oriented Computing</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

### Additional Requirements

1. At least 21 hours must be in graduate 500- and 700-level Computer Science courses (note: the Graduate School does not allow 500- and 700-level courses to be taken pass-fail).

2. "Restricted elective" courses may be any graduate letter-graded (500- or 700-level) course within the College of Engineering (including Computer Science), or within the College of Sciences. Exceptions that will *not* count towards graduation:
   - ST 511 (if taken after Spring 2014)
   - special topics courses (including EGR 590) in departments other than Computer Science (if taken after Fall 2012).

3. All Computer Science credits must be at or above the 500 level.

4. To graduate, a student must have at least a 3.00 grade point average (GPA). In addition, for students beginning their degree on or after Fall 2013, the GPA in the group of courses used to satisfy the core course requirement must be at least 3.0 as well. For additional Graduate School requirements regarding degree completion see the Graduate School Handbook.

5. A maximum of four special topics courses (either CSC 591 or CSC 791) may be counted towards graduation (for students beginning Fall 2012 or later).
6. Registration by MCS students in Independent Study (CSC 630) requires approval by the faculty member who will supervise the work, followed by submission to the DGP of a one page written description of the topic and expected outputs, and approval of the DGP. A grade of "S" will require submission of a report describing the work done, and the results obtained. A maximum of three credits of CSC 630 may be counted towards graduation.

7. Minors are neither required nor permitted.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Department Head
Gregory E. Rothermel, Professor

Distinguished University Research Professor
Donald L. Bitzer

Distinguished Professors
Tiffany M. Barnes
Mladen A. Vouk, Vice Chancellor for Research Development
Laurie A. Williams, Co-Director - NCSU Science of Security Tablet

Distinguished University Professor
James C. Lester II, Director of the Center for Educational Informatics
Michael A. Rappa, Director, Institute for Advanced Analytics

Alumni Distinguished Graduate Professor
Georgios N. Rouskas, Director of Graduate Programs
Munindar P. Singh, Co-Director - NCSU Science of Security Tablet

Full Professor
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Rada Y. Chirkova
Huaiyu Dai
Rudra Dutta, Associate Department Head
William H. Enck, Director of Wolfpack Security & Privacy Research (WSPR) Laboratory
Edward F. Gehringer
Xiaohui (Helen) Gu
Christopher G. Healey, Goodnight Distinguished Professor Analytics, Institute for Advanced Analytics
Steffen Heber
Timothy J. Menzies
R. Frank Mueller
Xipeng Shen
Matthias F. M. Stallmann
R. Raju Vatsavai

Associate Professors
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Marcelo d'Amorim
Zhishan Guo
Khaled Harfoush
Arnav H. Jhala
Alexandros Kapravelos
Sandeep K. Kuttal
Xu Liu
Collin F. Lynch
Noboru Matsuda
Kemafor Anyanwu Ogan
Bradley G. Reaves
David L. Roberts, Assistant Director of Undergraduate Programs
Alessandra Scafuro
Muhammad Shahzad
Donald R. Sheehy
Kathryn T. Stolee
Assistant Professors
Samira Mirbagheri Ajorpaz
Veronica M. Cateté
Anupam Das
Shiyan Jiang
Jung-Eun Kim
Chin Ho Lee
Jiajia Li
Jianqing Liu
Xiao rui Liu
Yuchen Liu
John-Paul Ore
Thomason W. Price
Dongkuan (DK) Xu
Dominik Wermke
Bowen Xu
Chenhan Xu
Man Ki Yoon
Ruozhou Yu

Teaching Professor
Sarah S. Heckman, Director of Undergraduate Programs

Teaching Associate Professors
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Tzvetelina (Lina) Battestilli
Jamie A Jennings
Jason T. King
Chandrika Satyavolu
Jessica Y. Schmidt
David B. Sturgill

Teaching Assistant Professors
Suzanne M. Balik
Abida Haque
Caio Batista de Melo
Alexander Card
Ignacio X. Domínguez
Adam Gaweda
Shuyin Jiao
Sterling M. McLeod

Lecturers
B. Jasmine Adams, Director of Undergraduate Advising
Margaret Heil, Director of Senior Design Center
ToniAnn Marini, Assistant Director of Undergraduate Advising

Research Professor
Franc Brglez

Assistant Research Professor
Bita Akram

Director
Leslie Rand-Pickett, Graduate Career Services

Emeritus Faculty
Dennis R. Bahler
Wu-show Chou
Jon Doyle
Edward W. Davis, Jr.
Robert J. Fornaro
Thomas L. Honeycutt
David F. McAllister
Harry Perros
Douglas S. Reeves
Woodrow Robbins
Carla D. Savage
William J. Stewart
Alan L. Tharp
David J. Thuente

Adjunct Faculty
Ram Chillarege
Aldo Dagnino
Steven Hunter
Chris Martens
Wookhee Min
Peng Ning
Christopher Parnin
Injong Rhee
Robert St. Amant
Xiaogang (Cliff) Wang
Tao Xie