Quick Guide for the CS@CU
MS Bridge Program in Computer Science

I. Bridge Program Curriculum

This Quick Guide is for CS@CU MS Bridge Program students completing their Bridge curriculum, typically over the first two or three semesters. CS@CU MS Bridge Program students first study a foundational curriculum consisting of one calculus and four computer science courses. They then take two track courses depending on their intended MS specialization.

Calculus Requirement (3 points)

The CS@CU MS Bridge Program requires all students to take **Calculus I (MATH UN1101, 3pts)** or its equivalent. This course covers functions, limits, single-variable differentiation, and single-variable integration.

CS Bridge Core Curriculum (14 points)

The foundational curriculum for CS@CU MS Bridge Program students consists of the following four required courses. 1004, 3134, and 3157 should be taken sequentially and will provide the necessary preparation for the MS tracks and advanced courses. 3203 may be taken concurrently with either 3134 or 3157.

1. **Introduction to Computer Science and Programming in Java (COMS W1004, 3pts)**: Covers fundamental concepts of computer science, algorithmic problem-solving capabilities, and introductory Java programming skills.

2. **Data Structures in Java (COMS W3134, 3pts)**: Covers data types and structures; programming techniques for processing structures, storage management, and analysis of algorithms.

3. **Advanced Programming (COMS W3157, 4pts)**: Covers practical programming techniques and tools for professional software construction, including writing code according to specifications and documentation. Taught in C and C++ in a UNIX environment; scripting languages and basic web programming included.

4. **Discrete Mathematics (COMS W3203, 4pts)**: Covers logic and proofs, mathematical induction, modular arithmetic, counting theory, graph theory, and discrete probability.

Calculus I and/or COMS W1004 (up to 6 points) may be waived on a case by case basis if taken with a B or higher grade at an accredited institution. Documentation must be provided.

Track Curriculum (6-7 points)

Alongside the Core, the CS@CU MS Bridge Program requires two additional track courses. Students will typically follow one of the tracks listed below. Course substitutions may be considered on a case by case basis.

Track A

This track is for students who intend to pursue the Foundations of Computer Science, Computer Security, Network Systems, or Software Systems track in the MS program.

1. **Computer Science Theory (COMS W3261, 3pts)**: Covers regular languages, context-free languages, Turing machines, Chomsky hierarchy, Church-Turing thesis, complexity theory, and NP-completeness.

2. **Fundamentals of Computer Systems (CSEE W3827, 3pts)**: Covers fundamentals of computer organization and digital logic.

Track B

This track is for students who intend to pursue the Computational Biology, Machine Learning, Natural Language Processing, or Vision, Graphics, Interaction, and Robotics track in the MS program. Two courses should be chosen from the following list, depending on the student's math background.

1. **Calculus III (MATH UN1201, 3pts** or **MATH UN1205, 3pts** or **APMA E2000, 4pts)**: Covers vectors, vector-valued functions, functions of several variables, partial derivatives, gradients, surfaces, optimization, and the method of Lagrange multipliers.

2. **Linear Algebra and Probability** (**MATH UN2015, 3pts**): Covers linear algebra with a focus on probability and statistics. Linear algebra topics include systems of linear equations, matrices, determinants, vector spaces, bases, dimension, eigenvalues and eigenvectors, the Spectral Theorem and singular value decompositions. Probability topics include conditional probability, discrete and continuous random variables, probability distributions and the limit theorems.

3. **Computational Linear Algebra (COMS W3251, 4pts)** or **Linear Algebra (MATH UN2010** or **APMA E3101, 3pts)**: Covers vectors, matrices, systems of linear equations, vector spaces, linear transformations, eigenvalues and eigenvectors, and the singular

value decomposition. COMS W3251 also includes a programming component in Python and introduces applications of linear algebra in computer science.

4. **Calc-Based Intro to Statistics (STAT UN1201, 3pts)** or **Probability for Engineers (IEOR E3658, 3pts)**: Covers random variables, probability distributions, pdf, cdf, mean, variance, correlation, conditional distributions, and other topics.

5. **Mathematics for Machine Learning (COMS W3770, 3pts)**: Preliminary exposure to core algorithms such as linear regression, gradient descent, principal component analysis, low-rank approximations, and kernel methods.

Students who have not taken multivariable calculus should first take a course from 1. The second course can then be chosen from one of 2, 3, 4, or 5 depending on prior background in linear algebra and probability. Note that 5 (COMS W3770) requires linear algebra and recommends basic probability knowledge as prerequisites.

Students who have taken multivariable calculus should first take a course from 2 or 3 if they have not taken linear algebra. They can then take either 4 for a full course on probability, and/or 5 provided that they have a basic background in probability.

Scheduling your CS Bridge Curriculum

A typical CS@CU MS Bridge Program student is expected to complete the Bridge curriculum in 2 or 3 semesters. This program allows for students to start in either the summer or fall semester. Please note that summer courses typically progress at twice the pacing as fall and spring courses, and that course availability may be limited. We recommend that students take at least two and up to three or four courses per semester. Some example schedules are shown below.

Example Track A schedule:
    Semester 1: COMS 1004, Calculus I
    Semester 2: COMS 3134, COMS 3203
    Semester 3: COMS 3157, COMS 3261, CSEE 3827

Example Track B schedule:
    Semester 1: COMS 1004, Calculus I
    Semester 2: COMS 3134, COMS 3203
    Semester 3: COMS 3157, Calculus III, Math 2015

Following successful completion of the CS@CU MS Bridge curriculum, students will seamlessly transition into the MS program coursework as described on the next page.

II. MS Program Curriculum

The Master of Science (MS) program provides a unique opportunity to develop leading-edge in-depth knowledge of specific computer science disciplines. The department currently offers concentration tracks covering eight such disciplines.

All students must complete the following requirements:

- Complete a total of 30 points.
- Maintain at least a 2.7 overall GPA.
- Satisfy breadth requirements.
- Take at least 6 points of technical courses at the 6000-level.
- Only up to 3 points of your degree can be non-CS/non-track courses. Non-CS/non-track courses must be approved by your advisor. See track webpages for more information.

Students can choose from one of the tracks below. See track webpages for details on track requirements.

- Computational Biology
- Computer Security
- Foundations of Computer Science
- Machine Learning
- Natural Language Processing
- Network Systems
- Software Systems
- Vision, Graphics, Interaction, and Robotics
- MS Personalized
- MS Thesis