The following is our list for pre-approved substitutes for the Programming and Computation Certificate (previously the Elements of Computing Certificate).

Please note:

- Students need only pass the course (a C- or better) to receive substitute credit. No paperwork is necessary for the courses listed below.
- A substitute course cannot also count along with the certificate course. For example, a student cannot take both CHE 348 and C S 323E and have both count toward the certificate. By extension, a student could not take CH 348 and M 348 and have both count toward the certificate. **Be aware that your audit may say otherwise.**

Upper Division Course Substitutions

Substitution Course	Elements Equivalent	Approved Through
CHE 348: Numerical Methods in Chem Engineering & Problem Solving	C S 323E: Elements of Scientific Programming	Summer 2027
M 348: Scientific Computation in Numerical Analysis	C S 323E: Elements of Scientific Programming	Summer 2027
ME 318M: Programming & Engineering Computational Methods	C S 323E: Elements of Scientific Programming	Summer 2027
PHY 329: Introductory Computational Physics	C S 323E: Elements of Scientific Programming	Summer 2027
I 320D: Database Design	C S 327E: Elements of Databases	Summer 2027
BAX 325: Database Management (previously BAX 327: Data Management)	C S 327E: Elements of Databases	Summer 2027
MIS 325: Database Management	C S 327E: Elements of Databases	Summer 2027
MIS 372T: Web Application Development with AI (previously MIS 333K: Web Application Development)	C S 329E: Elements of Web Programming	Summer 2027
SDS 366: Data Visualization (previously SDS 375: Data Visualization in R)	C S 329E: Elements of Data Visualization	Summer 2027
BCH 339N: Systems Biology & Bioinformatics	C S 329E: Elements of Data Analytics	Summer 2027
BAX 357: Predictive Analytics	C S 329E: Elements of Data Analytics	Summer 2027
MIS/MKT/BAX 372T: Predictive Analytics and Data Mining	C S 329E: Elements of Data Analytics	Summer 2027
M 339G/M 389G: Predictive Analytics	C S 329E: Elements of Data Analytics	Summer 2027
COE 332: Software Engineering & Design	C S 330E: Elements of Software Engineering I	Summer 2027
LIN 373N: Machine Learning	General Upper-Division Elements Elective	Summer 2027
NEU 446M: Quantitative Methods in Neuro 1	General Upper-Division Elements Elective	Summer 2027
PGE 379/383: High Performance Computing	General Upper-Division Elements Elective	Summer 2027
SDS 322E: Elements of Data Science	General Upper-Division Elements Elective	Summer 2027
BME 313L: Intro to Numerical Methods in Biomedical Engineering	C S 323E: Elements of Scientific Programming	Summer 2027
SDS 336: Practical Machine Learning	C S 329E: Elements of Data Analytics	Summer 2027

M E 365D: Data Science for Engineers	C S 329E: Elements of Data Analytics	Summer 2027

We will honor the following courses as substitutes for C S 303E *if taken no later than Summer 2021*: MIS 304: Intro to Problem Solving & Programming, EE 312: Software Design & Implementation 1, COE 301: Introduction to Computer Programming, BME 303: Introduction to Computing, and SDS 322: Introduction to Scientific Programming.
We will also honor EE 422C: Software Design & Implementation 2 as a substitute for C S 313E if taken no later than Summer 2021.