## Studies Plan

### Science et ingénierie computationelles 2022-23

#### Master project

<table>
<thead>
<tr>
<th>Courses</th>
<th>MP Autumn</th>
<th>MP Spring</th>
<th>Exam</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projet de master en science et ingénierie computationelles</td>
<td>900h</td>
<td>900h</td>
<td>Sum</td>
<td>Oral</td>
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#### Block SHS Master

<table>
<thead>
<tr>
<th>Courses</th>
<th>Exam</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSS : Introduction to project</td>
<td>Win</td>
<td>3</td>
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<tr>
<td>HSS : Project</td>
<td>Sum</td>
<td>3</td>
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</table>

#### Group 1

<table>
<thead>
<tr>
<th>Courses</th>
<th>Master 1</th>
<th>Master 2</th>
<th>MP Autumn</th>
<th>MP Spring</th>
<th>Exam</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>CSE project I</td>
<td>8h</td>
<td>8h</td>
<td>Sum</td>
<td>During the semester</td>
<td>8</td>
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<tr>
<td>CSE project II</td>
<td>8h</td>
<td>8h</td>
<td>Sum</td>
<td>During the semester</td>
<td>8</td>
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<tr>
<td>Engineering internship (master in computational sciences and engineering)</td>
<td>320h</td>
<td>320h</td>
<td>320h</td>
<td>320h</td>
<td>Sum</td>
<td>During the semester</td>
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#### Block 1

<table>
<thead>
<tr>
<th>Courses</th>
<th>Master 1</th>
<th>Master 2</th>
<th>Exam</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced numerical analysis</td>
<td>Picasso</td>
<td>2h 2h</td>
<td>Win</td>
<td>Written</td>
</tr>
<tr>
<td>Algorithms</td>
<td>Kapralov</td>
<td>4h 2h</td>
<td>Win</td>
<td>Written</td>
</tr>
<tr>
<td>Computer simulation of physical systems I</td>
<td>Pasquarrello</td>
<td>2h 2h</td>
<td>Win</td>
<td>Oral</td>
</tr>
<tr>
<td>Image processing I</td>
<td>Unser Van De Ville</td>
<td>3h</td>
<td>Win</td>
<td>Written</td>
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<tr>
<td>Introduction to multiprocessor architecture</td>
<td>Falsafi</td>
<td>2h 1h</td>
<td>Win</td>
<td>During the semester</td>
</tr>
<tr>
<td>Machine learning</td>
<td>Flammarion Jaggi</td>
<td>4h 2h</td>
<td>Win</td>
<td>Written</td>
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<tr>
<td>Molecular dynamics and Monte-Carlo simulations</td>
<td>Röthlisberger</td>
<td>1h 1h</td>
<td>Sum</td>
<td>During the semester</td>
</tr>
<tr>
<td>Numerical analysis and computational mathematics</td>
<td>Vazquez Hernandez</td>
<td>2h 2h</td>
<td>Win</td>
<td>Written</td>
</tr>
<tr>
<td>Parallel and high-performance computing</td>
<td>Antolin Sanchez</td>
<td>2h 1h 1h</td>
<td>Win</td>
<td>Oral</td>
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C: Courses, E: Exercice, P: Pratic courses, *: option courses / F: French courses, D: Deutsch courses, E: English Courses / Sum: Summer, Win: Winter
### Courses

<table>
<thead>
<tr>
<th>Language Code</th>
<th>Section</th>
<th>Teacher/Specialization</th>
<th>Master 1</th>
<th>Master 2</th>
<th>Exam Session</th>
<th>Exam Credit</th>
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#### Programming concepts in scientific computing
- **MATH-458**  
  - MA  
  - Anciaux  
  - 2h 2h  
  - Win  
  - During the semester  

#### Software engineering
- **CS-305**  
  - IN  
  - Candea  
  - 2h 1h 1h  
  - Win  
  - During the semester  

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**Group 2**

#### Courses

<table>
<thead>
<tr>
<th>Language Code</th>
<th>Section</th>
<th>Teacher/Specialization</th>
<th>Master 1</th>
<th>Master 2</th>
<th>Exam Session</th>
<th>Exam Credit</th>
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</tbody>
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#### Advanced algorithms
- **CS-450**  
  - IN  
  - Chiesa  
  - Kapralov  
  - 4h 3h  
  - Sum  
  - Written  
  - 8  

#### Advanced multiprocessor architecture
- **CS-471**  
  - IN  
  - 4h  
  - Win  
  - During the semester  

#### Applied data analysis
- **CS-401**  
  - SC  
  - West  
  - 2h 2h  
  - Win  
  - Written  
  - 8  

#### Artificial neural networks/reinforcement learning
- **CS-456**  
  - IN  
  - Gerstner  
  - 2h 2h  
  - Sum  
  - Written  
  - 5  

#### Atomistic and quantum simulations of materials
- **MSE-468**  
  - MX  
  - Pizzi  
  - 3h 1h  
  - Sum  
  - During the semester  

#### Computational finance
- **FIN-472**  
  - IF  
  - Pasricha  
  - Pulido  
  - Nino  
  - Wunderlich  
  - 2h 2h  
  - Win  
  - Written  
  - 5  

#### Computational linear algebra
- **MATH-453**  
  - MA  
  - Kressner  
  - 2h 2h  
  - Sum  
  - Oral  
  - 5  

#### Computational methods in molecular quantum mechanics
- **CH-452**  
  - CGC  
  - Bonella  
  - 2h 1h  
  - Win  
  - Oral  
  - 4  

#### Computational neurosciences: neuronal dynamics
- **NX-465**  
  - NX  
  - Gerstner  
  - 2h 2h  
  - Sum  
  - Written  
  - 5  

#### Deep learning
- **EE-559**  
  - EL  
  - 2h 2h  
  - Sum  
  - Written  
  - 4  

#### Distributed intelligent systems
- **COM-502**  
  - SC  
  - Thiran  
  - 2h 1h  
  - Sum  
  - Written  
  - 4  

#### Dynamical system theory for engineers
- **ENG-420**  
  - SiE  
  - Crouzy  
  - Porté  
  - Agel  
  - 2h 1h  
  - Win  
  - Written  
  - 5  

#### Environmental transport phenomena
- **COM-406**  
  - IN  
  - Urbanke  
  - 4h 2h  
  - Win  
  - Written  
  - 8  

#### Foundations of Data Science
- **CS-457**  
  - IN  
  - Pauly  
  - 3h 2h  
  - Win  
  - During the semester  

#### Hydrodynamics
- **ME-444**  
  - GM  
  - Gallaire  
  - 2h 2h  
  - Sum  
  - Written  
  - 5  

#### Image processing II
- **MICRO-512**  
  - MT  
  - Liebling  
  - Sage  
  - Unser  
  - Van De Ville  
  - 3h  
  - Sum  
  - Written  
  - 3  

#### Information security and privacy
- **COM-402**  
  - IN  
  - Busch  
  - Larus  
  - Pyrgelis  
  - 3h 1h 2h  
  - Win  
  - Written  
  - 8  

#### Instability
- **ME-466**  
  - GM  
  - Gallaire  
  - 2h 1h  
  - Win  
  - Written  
  - 3  

#### Introduction to electronic structure methods
- **CH-353**  
  - CGC  
  - Röthlisberger  
  - 3h 2h  
  - Win  
  - During the semester  

#### Low-rank approximation techniques
- **MATH-403**  
  - MA  
  - Kressner  
  - 2h 2h  
  - Win  
  - Oral  
  - 5  

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<table>
<thead>
<tr>
<th>Course Title</th>
<th>Code</th>
<th>Credits</th>
<th>Mode</th>
<th>Duration</th>
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<tbody>
<tr>
<td>Mathematical foundations of signal processing</td>
<td>COM-514</td>
<td>3h 2h</td>
<td>Win</td>
<td>Written</td>
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<tr>
<td>Mathematical modelling of behavior</td>
<td>MATH-463</td>
<td>2h 2h</td>
<td>Win</td>
<td>Written</td>
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<tr>
<td>Mathematical modelling of DNA</td>
<td>MATH-481</td>
<td>2h 2h</td>
<td>Win</td>
<td>Oral</td>
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<tr>
<td>Mathematics of data: from theory to computation</td>
<td>EE-556</td>
<td>3h 3h</td>
<td>Win</td>
<td>Written</td>
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<tr>
<td>Molecular quantum dynamics</td>
<td>CH-453</td>
<td>2h 1h</td>
<td>Sum</td>
<td>Oral</td>
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<tr>
<td>Numerical approximation of PDEs</td>
<td>MATH-451</td>
<td>2h 2h</td>
<td>Sum</td>
<td>Written</td>
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<tr>
<td>Numerical flow simulation</td>
<td>ME-474</td>
<td>2h 2h</td>
<td>Win</td>
<td>During the semester</td>
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<tr>
<td>Numerical integration of stochastic differential equations</td>
<td>MATH-450</td>
<td>2h 2h</td>
<td>Sum</td>
<td>Written</td>
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<tr>
<td>Numerical methods for conservation laws</td>
<td>MATH-459</td>
<td>2h 2h</td>
<td>Win</td>
<td>Oral</td>
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<tr>
<td>Numerics for fluids, structures &amp; electromagnetics</td>
<td>MATH-468</td>
<td>2h 2h</td>
<td>Win</td>
<td>Oral</td>
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<tr>
<td>Optimization for machine learning</td>
<td>CS-439</td>
<td>2h 2h 1h</td>
<td>Sum</td>
<td>Written</td>
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<tr>
<td>Principles and applications of systems biology</td>
<td>CHE-411</td>
<td>2h 1h</td>
<td>Win</td>
<td>During the semester</td>
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<tr>
<td>Signal processing for communications</td>
<td>COM-303</td>
<td>4h 2h</td>
<td>Sum</td>
<td>Written</td>
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<tr>
<td>Statistics for data science</td>
<td>MATH-413</td>
<td>4h 2h</td>
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<td>Stochastic simulation</td>
<td>MATH-414</td>
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<tr>
<td>Structural biology</td>
<td>BIO-315</td>
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<td>Sum</td>
<td>During the semester</td>
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<tr>
<td>Systems for data management and data science</td>
<td>CS-460</td>
<td>2h 2h 2h</td>
<td>Sum</td>
<td>Written</td>
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<tr>
<td>Turbulence</td>
<td>ME-467</td>
<td>3h 2h</td>
<td>Sum</td>
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<td>Understanding advanced molecular simulation</td>
<td>CH-420</td>
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<tr>
<td>Water quality modelling</td>
<td>ENG-400</td>
<td>2h 2h</td>
<td>Win</td>
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