The International Bachelor Y  
Modelling and Data Science for a changing world  
University of Paris Seine  
A high-level challenge-based programme in Europe, Asia, Africa  
Starting: September 2018

Andrew Hamilton (NYU): There is no more important mission for universities than to expose students to the world and to its complexity

LEARN / IMAGINE / CREATE / COOPERATE  
to address contemporary issues and have an impact on tomorrow's world

REFERENCES

Paris Seine initiative: a label of academic excellence for French world leading universities supported by the government, bringing together University of Cergy-Pontoise (UCP), ESSEC, EISTI, ENSEA

Professional insertion: EISTI France #1 for its Engineering diploma, UCP France #1 for its Masters in Economics, UCP France #4 for salaries of graduates, ESSEC World #3 for its Master in Management, 20 chairs of excellence with world leading companies

Research: UCP World top 200 in Mathematics (Shanghai), ESSEC top 200 in Finance (Shanghai), joint research labs with CNRS, an institute for advanced studies, 600 researchers

Experience: French « classes préparatoires », internship and apprenticeship based training, project based and problem based pedagogy, open access to fablabs and creative platforms, open access to research labs
THE PROGRAMME PHILOSOPHY

Aims
- A 4 year challenge based programme for excellent and curious students, with a curriculum designed to have an impact on the world of tomorrow
- The Bachelor trains future international leaders in data sciences, cybersecurity, artificial intelligence, economics and finance engineering, quantum engineering
- For future top scientists, engineers and managers, both French and English speaking, open to the global complexity of the world

Means
- A combination of French high standard scientific training (« classes préparatoires ») + ability to learn through innovative pedagogy + openness to research and challenges of the 21st century
- A triple location (Europe, Asia-Pacific, Africa) for greater mobility and openness to the world. For the academic year 2018-2019, there will be only one group in France and students will have an international mobility during their studies. From academic year 2019-2020; the triple location training will open and students will have to study in at least 2 locations.
- A backbone in Mathematics, and applications to economy, finance, statistics, mathematical modeling, data analysis, artificial intelligence, cybersecurity, cryptology, quantum technology
- A programme run by University Paris Seine (French excellence initiative label) in partnership with Warwick University and AEFE

THE CURRICULUM

The Bachelor combines high demanding academic pedagogy similar to that of « classes préparatoires » (50%) with alternative pedagogy addressing challenges through problem solving and project driving (35%) as well as time for discovering and sharing (15%).

The Bachelor also enables the students to design their curriculum progressively: from 20% during the first year to 100% during the last year.

Throughout the 4 years of the Bachelor, students will experience learning, creating and giving, designing year after year the challenges they would like to tackle during their future professional and personal life, according to three main categories:
- Humanity and technology (living among data, robotics, quantum computing, cryptology)
- Humanity and the planet (forecasting climate challenges, modelling condensed matter behavior)
- Humanity and society (modelling sociological phenomenon, developing economics model for education or resources exchanges)
Each year starts with a discovery period, like and share, which will help orientate students towards designing their year curriculum. It features:

- attend high-level scientific conferences to address state of the art contemporary issues in the area of research
- conduct a project in connection with a personal challenge (with open access to research labs, resources, fablabs)
- search and imagine solutions relating to a given contemporary issue (with open access to research labs, resources, fablabs)
- create a piece of art (writing, acting, dancing, design)
- contribute to the diffusion of science to society
## Basics modules

Each line describes one year of the program.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Mathematics</th>
<th>Physics</th>
<th>Information Processing</th>
<th>Economics management and finance</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>At the beginning of the year, an initial module (face to face teaching : 3/2 days) : Welcome day, learning to learn: prepares students for the new pedagogical method in which the pupils are actors in their own learning process Learning for doing, doing to learn and learn from doing, Backbone 1st year transversal projects: the starting point is a challenge with Contractual Requirements ⇒ a business plan ⇒ plan the project ⇒ achieve the project. Teaching staff are there to guide and support students during their projects. Project example: Programming an electronic system. Tools for the project • Budget (20h MOOC) • Accounting (20h)</td>
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<tr>
<td>Year 1 :</td>
<td>30 weeks of 30 hours : • Integration : 30h • Contemporary Issues = 90h • Transversal Project : 200h • Basics = 420h • Diving Deeper = 100h</td>
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<td></td>
<td>Analysis in $\mathbb{R}$ (120h) Linear Algebra (80h) including Complex numbers and trigonometry Probability/Statistics(40h)</td>
<td>Electricity (30h) Cinematics (30h) Algorithmic (30h) Programming I (Python) (30h)</td>
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<td>Macroeconomics (30h) Microeconomics (30h)</td>
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</tbody>
</table>
| Year 2: | Analysis in R^n (40h)  
Series (40h)  
Differential equations (20h)  
Algebra (40h)  
Bilinear Linear Algebra (40h)  
Mathematical statistics (20h) | Electromagnetism and special relativity (60h)  
Wave physics (30h) | Data Analysis (30h)  
Signal theory (30h)  
Object analysis and Java programming (30h) | Principles of finance (20h)  
Principles of accounting (20h) |
|---|---|---|---|---|
| 30 weeks of 30 hours:  
- Integration : 10 hours  
- Contemporary Issues = 90h  
- Transversal Project : 200 hours  
- Basics = 420 hours  
- Diving Deeper = 100 hours | In this second project, students will develop skills in project analysis and decomposition and they will become more autonomous | | | |
| Year 3: | PDEs (30h)  
Introduction to measure theory (30h) | Introduction to Quantum mechanics (25h)  
Introduction to information theory (25h) | Data Mining (30h) | Managerial accounting (30h) |
|---|---|---|---|---|
| 30 weeks of 30 hours:  
- Contemporary Issues = 90h  
- Transversal Project : 250h  
- Basics = 170 hours  
- Diving Deeper = 300h | Company project carried out by the students under the teaching team supervision | | | |
<table>
<thead>
<tr>
<th>Year 4:</th>
<th>Functional Analysis (Hilbert space) (25h)</th>
<th>Statistical mechanics (25h)</th>
<th>Operational research (25h)</th>
<th>Game Theory (25h)</th>
</tr>
</thead>
</table>
| 30 weeks of 30 hours:  
- Contemporary Issues = 90h  
- Transversal Project : 300h  
- Basics = 100h  
- Diving Deeper = 350h | Entrepreneurship project | | | |
**Diving deeper modules** (the opening of deeper modules is subject to availability)

| Year 1 | Choose 2 100h | Mathematics (50h): logic and set theory  
Physics(50h): Newton mechanics  
Physics (50h) : optics (problem based)  
Data processing (50h) : relational databases and NOSQL (project based)  
Data processing (50h) : Android programming (project based)  
Economics (50h): Applied microeconomics issues |
|---|---|---|
| Year 2 | Choose 2 100h | Mathematics (50h): algebra  
Mathematics (50 h) : arithmetic applied to cryptography  
Physics (50 h) : Introduction to transport phenomena in fluids  
Physics (50h): Newton mechanics II  
Data processing (50 h) : electronics  
Data processing (50h): networks  
Data processing (50h): parallel and distributed programming  
Economics (50h): introduction to quantitative economy (problem pedagogy) |
### Year 3
Choose 5 among 11

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Mathematics (60h) : graph theory</td>
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<tr>
<td>Mathematics (60h) : complex analysis</td>
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<td>Mathematics (60h) : linear model</td>
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<td>Mathematics (60h): design and analysis of computer experiments</td>
<td>60</td>
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<tr>
<td>Mathematics (60h): experimental design and response surface</td>
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<tr>
<td>Physics (60h) : fluid mechanics</td>
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<td>Physics (60h) : quantum mechanics</td>
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<td>Physics (60h) : nuclear energy and waste renewable energy and sustainable development</td>
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<tr>
<td>Physics (60h) : Thermodynamic</td>
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<td>Data processing (60h) : artificial intelligence, machine &amp; deep learning</td>
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<tr>
<td>Data processing (60h) : data viz and visual computing</td>
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<tr>
<td>Data processing (60h) : smart systems and internet of things</td>
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<td>Economics (60h): forecasting model</td>
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<td>Economics (60h) : marketing</td>
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<td>Economics (60h): microeconometrics</td>
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### Year 4
Choose 5 among 11

<table>
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<tr>
<th>Subject</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Mathematics (70h) : data security</td>
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<td>Mathematics (70h) : dynamical systems</td>
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<td>Mathematics (70h) : stochastic optimization, heuristics</td>
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<td>Mathematics (70h) : multi-criteria programming and multi objective</td>
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<td>Mathematics(70h): measure theory and distributions</td>
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<td>Physics (70h) : classical and quantum information theory</td>
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<td>Physics (70h) : advanced quantum mechanics</td>
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<td>Physics (70h) : symmetries in physics</td>
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<td>Physics (70h) : condensed matter</td>
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<td>Data processing (70h): language processing and text mining</td>
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<td>Data processing (70h) : biomedical data</td>
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<td>Data processing (70h) : digital architecture</td>
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<td>Data processing (70h): Big data and cloud computing</td>
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<td>Data processing (70h): security and privacy in IoT</td>
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<td>Economics (70h) : stochastic modelling applied to finance</td>
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<td>Economics (70h) : options, futures and other financial derivatives</td>
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<td>Economics (70h) : development economics</td>
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<tr>
<td>Economics (70h) : public and environmental economics</td>
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Mathematics Year 1

First semester: Analysis 60h (real numbers, sequences, functions of one real variable: continuity differentiability, derivatives), Algebra 40h (complex number and trigonometry, algebraic structures, polynomials; rational fractions), Probability/Statistics 20h

Second semester: Analysis 60h (Taylor expansion, integration differential equations), Algebra 40h, (vector spaces, linear applications, matrices determinants, linear systems) Probability/Statistics 20h

Mathematics Year 2

First semester: Analysis 60h (series, function sequences and series, power series, Fourier series) Algebra 40h, (linear algebra, matrix diagonalization and applications)

Second semester: Analysis 40h (analysis in Rn, differential calculus) Algebra 40h (bilinear algebra: quadratic forms, Euclidian spaces), Probability/Statistics 20h
**Contemporary Issues modules (30h each)**

- Historical cryptography
- Statistics and data analysis: what polls say and don’t
- Computer and smartphone operating system: understand the tool I use every day!
- Network and Internet: how are we connected?
- Economy and game theory: should I cheat or should I cooperate?
- Philosophical issues if the 21st century
- Sapiens, a brief history of humanity
- Chemistry and synthesized materials: polymers for daily life
- Biology and natural materials: protect and regenerate
- Introduction to cognitive science: how do I think?
- Sustainable Development and Corporate Social Responsibility
- Relativity is everywhere
- Information: our new gold

**Throughout the year (number of hours according to the year of enrollment):**

- Follow up a main project with a team in connection with a CNRS research lab (in Mathematics / Physics, Economics, Computer Sciences)
- Internship
- Explore French / English language and culture
- Follow the conferences cycle of the Institute of Advanced Studies on global issues of the 21st century (technology, planet, society)
- Give some of your time to share science or your passion with kids, younger students and members of the public
- Self-development through sport, art, culture, ideas, or by leading an association

**Details of compulsory modules for the first year**

**Analysis in 𝕀:**
- Continuity, derivability, integration, sequences, series

**Algebra I:**
- Linear algebra, matrix, vector space

**Probability:**
- Probability spaces, discrete and continuous random variables, conditional probability

**Project management**
- Gant, Perth diagrams, SWOT, Agile