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### Some history

In 1830, Évariste Galois created a course called *algèbre supérieure*, because he disagreed with the methods of teaching mathematics. More than a century later, the *Nicolas Bourbaki* group developed a new approach to mathematics and its teaching, which caused the emergence of many renowned mathematicians, so much so that even today, being French is often synonymous with “being good at maths”. In both cases, these eminent mathematicians offered an approach and a methodology that parted with the teachings of their time, which they considered, in particular, to lack rigour and consistency.

### What did I notice?

During my years of teaching mathematics at university, I was able to observe the way in which students approached mathematics, and noted their lack of knowledge and mastery of the fundamentals, generating a misunderstanding of the subject. Some learning techniques, especially those based on memorisation, have been neglected in favour of longer explanations, misrepresented as more intuitive and generally so convoluted that they end up being even more complicated. This approach completely undermines what math education is all about, and produces sloppy and rather poorly educated students.

### What consequences can this have?

In many fields such as computer science or finance, mastery of mathematics is necessary, even essential. During a recruitment interview, it is indeed common for the candidate to be tested to check their level of knowledge. Intensified competition due to the increase in the number of students, in addition to the system which encourages more and more lax notations, means that obtaining a higher education degree, such as a Bachelor's or even Masters, no longer guarantees a remunerated job commensurate with the achievements. The selection being done sooner or later, it is essential to guarantee to have a solid training especially if it is accompanied by a significant student debt.

### What motivated me to develop this program?

I talked a lot with people from the teaching staff, and most were in agreement with my observations, analyses and conclusions. On the strength of these observations, and being concerned, even worried, about the methods of teaching mathematics, used in the United States, but also in France, I decided, following the example and in the spirit of Galois and of the Bourbaki group, to develop appropriate program, which would allow students to acquire the fundamentals, efficiently and quickly. The concepts are studied in more detail with application exercises in physics, finance or economics. In addition to an adequate education in mathematics, it is also a work methodology that will

extend beyond school, the goal being also to maximise the chances of success in higher education as well as the best chances for the most selective establishments.

### What are the necessary prerequisites?

In addition to motivation, only the ability to read, write and count is necessary.

### Who is the target audience?

The program can be started from the age of 11 or 12 depending on the profile, but is also aimed at older students to prepare for higher education, as well as adults returning to their studies in order to obtain an MBA or Masters' degree which would require a refresher in mathematics.

### What is the material needed?

Upon registration, geometry instruments, two notebooks, a *Mathematica* license and the textbook will be provided. The rest will be the responsibility of the student and the use of a computer will be necessary for learning computer coding.

### What are the benefits?

With considerable economies of scale resulting from consistent instruction that minimises redundancy, the program would equate to the entire curriculum covered in middle school, high school, and 1-2 years of higher education as well as some physics, economics and finance. All in much less time (62 weeks at the rate of one session of 2h30min per week in the best case), and the level attained will certainly culminate in high marks in school, at the *Brevet des Collèges*, *French Baccalaureate*, standardised tests such as the *SAT*, as well as a significant advance on higher education studies.

- Can be started at any time during the year in small groups of 10 students maximum.
- The program can be chosen in English or in French.
- Every week, 1 hour of office hours online.
- Training in coding with *Mathematica* and Python, as well as *LATeX* for writing papers (useful in all subjects), CV, cover letter, etc...
- Importance will be given to certain aspects of mathematics which are too often neglected such as presentation, the correct use of notation and calculator.
- Development of a good work methodology through, for example, the use of scratch paper or the creation of formula sheets.
- Several types of grading will be provided for each assignment, in order to be able to follow the progress of several aspects:
  - A score out of 100, with points awarded only when the answer is completely correct.
  - A score out of 100, with partial points but high standards.
  - A grade supposed to reflect what would be obtained at the university.
  - A presentation grade.
- At the end of the program, a personalised recommendation as well as contacts and assistance will be provided in the application process for American, British or French universities, as well as for *classes préparatoires aux grandes écoles*.

### Schedule of the program

- Several times are available depending on the frequency of classes chosen (one to two sessions per week is recommended). Sessions last 2h30min.

Monday and Tuesday	Wednesday	Thursday and Friday	Saturday and Sunday
6pm – 8:30pm	2pm – 4:30pm and 4:45pm – 7:15pm	6pm – 8:30pm	10am – 12:30pm and 1:30pm – 4pm

Table 1: *Schedule*

- Although everyone starts at level 1a, each student can complete the levels at their own pace, with all 4 levels taking an average of 1 to 3 years.
- Validation tests for each level will be offered regularly. Students will also be offered, if they so wish, the opportunity to take *khôlles* (oral exercises), the mathematics examination for the *Brevet National des Collèges* or the *Baccalaureate* under the same conditions in order to measure progress.

Niveaux	Sujets
1	1a Algebra and Set Theory 1b Geometry 1 1c General Mathematics 1d Linear Algebra 1e Geometry 2
2	Calculus
3	Probability and Statistics
4	Logic
5	Arithmetic

Table 2: *Curriculum*

- During school holidays, intensive courses with daily classes are available.
- Trips between Paris, Boston and London can be organized, combining courses with visits to university campuses, the city and meetings with professors from local universities.

### End of the program

- What will have been learned, not counting optional courses, covers the program of university courses listed below (non-exhaustive list). Those with \* are not totally covered, but mostly. University credits can, perhaps, be obtained by equivalence for certain institutions.

**MIT**

18.01: Calculus, 18.02\*: Calculus, 18.05: Introduction to Probability and Statistics, 18.06\*: Linear Algebra, 18.090\*: Introduction to Mathematical Reasoning

**Harvard University**

Mathematics *MA*: Introduction to functions and calculus I, Mathematics *MB*\*: Introduction to functions and calculus II, Mathematics *1A*: Introduction to calculus, Mathematics *1B*\*: Integration, series and differential equations, Mathematics *18B/19B*\*: Linear algebra, probability and statistics, PhySci *3*\*: Electromagnetism, Circuits, Waves, Optics, and Imaging, Stat *110*: Introduction to probability

**Boston University**

MA 111: Mathematical Exploration, MA 113: Elementary Statistics, MA 115: Statistics I, MA 116\*: Statistics II, MA 119\*: Applied Mathematics for Personal Finance, MA 120: Applied Mathematics for Social and Management Sciences, MA 121: Calculus for the Life and Social Sciences I, MA 122\*: Calculus for the Life and Social Sciences II, MA 123: Calculus I, MA 124\*: Calculus II, MA 193: Discrete Mathematics for Engineering, MA 213: Basic Statistics and Probability, MA 214\*: Applied Statistics, MA 225\*: Multivariate Calculus, MA 242\*: Linear Algebra, MA 293\*: Discrete Mathematics, MA 531\*: Mathematical Logic, PY 106\*: Physics 2, PY 212\*: General Physics 2, PY 252\*: Principles of Physics 2

- Subjects usually studied in higher education may also be requested.

Option 1: Math 1	Linear Algebra Calculus 2 Calculus 3	Option 6: Math 2	Stochastic Calculus Real Analysis Complex Analysis
Option 2: Classical Physics	Classical Mechanics Optics Electromagnetism Thermodynamics	Option 7: Math 3	Abstract Algebra Number Theory
Option 3: Chemistry	Atomistic Inorganic Chemistry Organic Chemistry	Option 8: Math 4	Differential Equations Differential Geometry
Option 4: Economics 1	Microeconomics Game Theory	Option 9: Relativistic Physics	Special Relativity General Relativity
Option 5: Economics 2	Macroeconomics Finance Financial economics	Option 10: Quantum Physics	Quantum Mechanics Quantum Computing Quantum Field Theory

Table 3: *Optional Courses*

## Calendar

The following schedule, based on 1 session per week, is provided as an indication, to get an idea of the minimum duration of the program as a whole.

Semaine	Sujets	Semaine	Sujets
1	<i>Algebra</i> , chapter 1 Exercises	2	<i>Algebra</i> , chapter 1 Exercises
3	<i>Set theory</i> , chapter 2 Exercises	4	<i>Set theory</i> , chapter 2 Exercises
5	Exercises level 1a	6	<b>Exam level 1a</b>
7	<i>Geometry 1</i> , chapters 8-10 Exercises	8	<i>Geometry 1</i> , chapters 8-10 Exercises
9	<i>Geometry 1</i> , chapters 8-10 Exercises	10	Exercises level 1b
11	<b>Exam level 1b</b>	12	Start of the initiation to <i>LaTeX</i> <i>General mathematics</i> , chapters 3-5
13	<i>General mathematics</i> , chapters 3-5 Exercises	14	Start of the initiation to <i>Mathematica</i> <i>General mathematics</i> , chapters 3-5 Exercises
15	<i>General mathematics</i> , chapters 3-5 Exercises	16	<i>General mathematics</i> , chapters 3-5 Exercises
17	<i>General mathematics</i> , chapters 3-5 Exercises	18	Start of the initiation to <i>Python</i> <i>General mathematics</i> , chapters 3-5 Exercises
19	Exercises level 1c	20	<b>Exam level 1c</b>
21	<i>Linear algebra</i> , chapters 6, 7 Exercises	22	<i>Linear algebra</i> , chapters 6, 7 Exercises

Semaine	Sujets	Semaine	Sujets
23	<i>Linear algebra</i> , chapters 6, 7 Exercises	24	<i>Linear algebra</i> , chapters 6, 7
25	Exercises level 1d Exercises	26	<b>Exam level 1d</b>
27	<i>Geometry 2</i> , chapters 11, 12 Exercises	28	<i>Geometry 2</i> , chapters 11, 12 Exercises
29	<i>Geometry 2</i> , chapters 11, 12 Exercises	30	Exercises level 1e
31	<b>Exam level 1e</b>	32	<i>Calculus</i> , chapters 13-16 Exercises
33	<i>Calculus</i> , chapters 13-16 Exercises	34	<i>Calculus</i> , chapters 13-16 Exercises
35	<i>Calculus</i> , chapters 13-16 Exercises	36	<i>Calculus</i> , chapters 13-16 Exercises
37	Exercises level 2	38	<b>Exam level 2</b>
39	<i>Mathematica</i>	40	<i>Python</i>
41	<i>Probability and statistics</i> , chapters 17-19 Exercises	42	<i>Probability and statistics</i> , chapters 17-19 Exercises
43	<i>Probability and statistics</i> , chapters 17-19 Exercises	44	<i>Probability and statistics</i> , chapters 17-19 Exercises
45	Exercises level 3	46	<b>Exam level 3</b>
47	<i>Mathematica</i>	48	<i>Python</i>

49	<i>Logic</i> , chapters 20-24 Exercises	50	<i>Logic</i> , chapters 20-24 Exercises
51	<i>Logic</i> , chapters 20-24 Exercises	52	Exercises level 4
53	<b>Exam level 4</b>	54	<i>Arithmetic</i> , chapters 25-27 Exercises
55	<i>Arithmetic</i> , chapters 25-27	56	<i>Arithmetic</i> , chapters 25-27
57	Exercises level 5	58	<b>Exam level 5</b>
59	Exercises Final Exam	60	Exercises Final Exam
61	Exercises Final Exam	62	<b>Final Exam</b>

### About me

I did my undergraduate studies in France at *University Paris VI* before moving to London where, after spending 6 months in the mathematics department of *Queen Mary University* conducting research in general relativity, I went to *Imperial College London* where I specialized in string theory. Concluding a third year in London studying finance and economics at the *London School of Economics*, I moved to Boston where I concluded my studies with a doctorate in mathematics from *Tufts University*. Finally, I taught mathematics, physics, economics and finance for many years in academic institutions such as *Harvard University* and *Boston University*.