Cluj, May 26, 2017

Magnifice Rector,
Dear President of the University Senate,
Dear Professors of the University Senate,
Dear Vice-Rectors,
Dear Deans,
Dear Professor Precup,
Dear Colleagues,
my Dearest Friend Professor Csaba,
Ladies and Gentlemen,

I am extremely moved for the exceptional honor, the Doctor Honoris Causa, I just received by the historic and great Babes-Bolyai University of Cluj-Napoca. Profound thanks to the Senate of the Babes-Bolyai University of Cluj-Napoca for this award stated on last October 2016.

The Università degli Studi di Perugia, my university, was founded in 1308 and is one of the oldest universities in Italy and one of the most accredited in Italy. My university offers a wide variety of courses in all fields of education. We provide to our students the finest quality degree programmes and academic opportunities within a stimulating multicultural environment, along with the opportunity to enjoy an excellent lifestyle and foster student's personal and academic growth while studying at the highest level. The mathematics program started in its modern form in 1966 and it is one of the traditional and stable curriculum of my university. The teaching staff, as well as the staff of the laboratories, secretary, library, and so on, are stable and of great maturity and experience. Furthermore, the continuous recruitment of new teaching staff provides good enthusiasm for innovation and experimentation.

The history of the Cluj University can be traced back to May 12, 1581, when a Jesuit Academic College was founded in the city. Even with the difficulties and the uncertainties of the life, the university education and the research activities in Cluj were continuously increasing in quality and number of papers produced. The Professors of the Cluj University, in spite of nationality, always worked, with abnegation and responsibility, on the development of the university and for of the perennial values promoted by it.

What is remarkable is that from the beginning and up today the mathematical studies in Romanian knew a continuous development, not only thanks to the increasing number of students, but mainly thanks to the high quality of the research and the scientific achievements in Mathematics achieved in the Babes–Bolyai University.

Mathematics is the Language of the Universe, wrote Galileo Galilei and the importance of mathematics and mathematics education is clear since ever. Indeed, there are two legacies of the Ancient Greeks: Democracy and Mathematics. It is clear that democracy cannot work without mathematics to calculate taxes or determine the seat distribution in parliament based on direct and indirect votes! Without mathematics, there would be no skyscrapers, no television, no computers, no commercial airlines, no spaceflight and no weather forecast. Without mathematics we would not be much more advanced than the ancient Babylonians. The cultural value and the monetary economic value of mathematics are too large to measure. More importantly, the laws of nature are written in the language of mathematics: from the equations of general relativity that govern the motion of planets, stars and galaxies everywhere in the universe, to the electrochemical signals in our brain. The underlying mathematics becomes more and more obvious in Quantum Mechanics.

It is really hard to come up with an area of mathematics which has no application in life. Indeed, more advanced areas of mathematics, such as Algebraic Topology or Category Theory, may not have obvious real life applications. However their study can easily be justified since it is impossible to predict how they could be used in the future, and because it is not unusual for links to appear between apparently unrelated areas of mathematics. There is no doubt that mathematics is of immense practical value in life. However, in the most popular examples of applications of mathematics, created by mathematicians, computer scientists and engineers, the user does not need to know or to apply mathematics! Indeed, the player does not need to know about matrices in order to play a 3D computer game! Furthermore, highly popular puzzles like Sudoku or the Rubiks Cube show that practicing mathematical and logical reasoning can be far from dry and boring.

We regularly use mathematics in our everyday life: from measuring distances and weights to reading timetables, estimating how much money we spent while shopping and interpreting percentages in newspapers. Usually, mathematicians and textbook authors start with a mathematical idea that needs to be taught and invent real world problems around them. The more realistic approach would be to start with a real world problem, think together with the students about the kind of mathematics necessary to solve the problem, and then link it with various parts of the book.

Mathematics has an important social role. Basic arithmetic and estimation is necessary in everyday life. Understanding and correctly interpreting data it important if one does not want to fall into traps when seeing published advertisements or reading the newspaper. At a more advanced level, one can criticise

mathematical and statistical models, approaches and results. Mathematics is Democracy.

Now, turning back to the history of Mathematics at the Babes-Bolyai University of Cluj-Napoca, I point out that of great interest in the scientific community in Cluj has been being the creation of several journals focused on papers that address significant problems in Mathematics. I just mention few of these journals of the Babes-Bolyai University of Cluj-Napoca: *Mathematica*, which started in 1929, with a famous paper by Paul Montel, a great mathematician from Paris; *Studia Universitatis Babes–Bolyai, series Mathematica*, which appeared in 1957 under of the name of *Bulletin of the Victor Babes and Janos Bolyai Universities Cluj-Natural Sciences Series*; *Revue d'Analyse Numérique et de Théorie de l'Approximation* (ANTA), which started thanks to Professor Tiberiu Popoviciu and which is now edited by the Tiberiu Popoviciu Institute on Numerical Analysis of the Romanian Academy, Cluj branch; *Didactica Mathematica*, which started in 1983 and which is in electronic form since 2013 under the management of Professor Dorel Duca; and last but not least *Fixed Point Theory – An International Journal on Fixed Point Theory, Computation and Applications*, which was founded in 2000 by Professor Ioan Rus and that is the first mathematical journal from Cluj indexed by Web of Science (ISI) since 2007. Nowadays the editor in chief is Professor Adrian Petrusel.

Famous mathematicians worked at the Cluj University. I have special feelings of gratitude for the wonderful Romanian mathematicians that influenced so much the international Mathematics. I just mention few of them, who are closer to my field of research, and I do apologize for just saying few words.

Professor *Gyula Farkas* held an impressive record of publications and wrote a paper on the iterative solution (called Farkas–Bolyai) of the trinomial equation by carefully studying the convergence of the algorithm. He also made a great contribution to Applied Mathematics and Physics.

Professor *Lipót Fejér*, awarded the second prize in the Eötvös Mathematics Competition, was the thesis advisor of mathematicians such as John von Neumann, Paul Erdös, George Pólya and Pál Turán. Fejér collaborated to produce important papers, one with Carathéodory on entire functions in 1907 and another major paper with Frigyes Riesz in 1922 on conformal mappings, with a short elegant proof of the Riemann mapping theorem.

Professor *Frigyes Riesz* did some of the fundamental work in developing functional analysis and his work has had a number of important applications in physics. Riesz established the spectral theory for bounded symmetric operators in a form very much like that now regarded as standard. He also made many contributions to other areas including ergodic theory and gave an elementary

proof of the mean ergodic theorem. Riesz founded the *Acta Scientiarum Mathematicarum journal* together with *Alfréd Haar*.

Professor *Alfréd Haar*, a former student of Hilbert, received the first prize in the Eötvös contest in mathematics. His scientific contributions range from differential equations to asymptotic developments, calculus of variations and approximation theory. Haar is best remembered for his work on analysis on groups. In 1932 he introduced a measure on groups, now called the Haar measure, which allows an analogue of Lebesgue integrals to be defined on locally compact topological groups. It was used by von Neumann, by Pontryagin in 1934 and by Weil in 1940 to set up an abstract theory of commutative harmonic analysis.

Professor *Dimitrie Pompeiu*, a former student of Henri Poincaré, a member of the Romanian Academy since 1934, posed a challenging conjecture in integral geometry, now widely known as *the Pompeiu problem*, and among his famous contributions in 1906 there is the construction of non–constant, everywhere differentiable functions, with derivative vanishing on a dense set. Such derivatives are now called *Pompeiu derivatives*.

Professor *George Calugareanu*, elected as a corresponding member of the Romanian Academy, was a preeminent professor of the Romanian University of Cluj, probably the most important successor of Dimitrie Pompeiu.

Professor *Tiberiu Popoviciu*, a former student of Paul Montel, member of the Romanian Academy, founded in 1951 a research institute which now bears his name: *Tiberiu Popoviciu Institute of Numerical Analysis*. We still call the Popoviciu inequality and the Popoviciu inequality on variances.

Professor *Dimitrie Stancu*, member of the Romanian Academy, was in the editorial board of the journal *Calcolo*, a quarterly on numerical analysis and theory of computation founded in 1964, as well as of many other important journals.

Professor *Petru T. Mocanu*, was a member of the Romanian Academy and, for many years, president of the Romanian Mathematical Society. Professor Mocanu was the creator of the Geometric Function Theory in Romania.

Last but not least I desire to mention my dear forever friend, Professor *Csaba Varga*, who is one of my truest friends and greatest supporters and gave generously his time and knowledge to me since I met him. Together with Professor *Varga Csaba* I jointly wrote several papers, some of them well cited.

My collaboration with Romanian mathematicians started in 2000 when Professor Vicentiu Radulescu came to Perugia for the first time. Later, in 2010, I invited Professor Csaba Varga for the first time to visit Perugia under the auspices of our national scientific group, called GNAMPA, and since then our collaboration was very active.

Indeed, we even started an Erasmus bilateral project and I was the Erasmus partner in Perugia. I just mention the visits of Professors Marian Muresan, Judit Robu and Adrian Petrusel, the Dean of the Faculty of Mathematics and Computer Science in Cluj-Napoca. But, naturally, also several colleagues of mine from Perugia visited the Mathematics Faculty in Cluj-Napoca, not only using the Erasmus founds. I just mention, in alphabetic order, Professors Giuseppina Autuori, Francesca Colasuonno, Roberta Filippucci, Dimitri Mugnai, Paola Rubbioni, Maria Cesarina Salvatori. On the other hand, some other mathematicians from Cluj-Napoca visited my department in Perugia, not only using the Erasmus founds. I just mention, in alphabetic order, Professors Csaba Farkas, Radu Precup and Csaba Varga.

I am a Perugian mathematician in the most complete way. I was born there, graduated under the supervision of Professor *Calogero Vinti* and made almost my whole career at the University of Perugia and I love my Etruscan city from the bottom of my heart.

Professor *Calogero Vinti* had close scientific and personal contacts with *Lamberto Cesari*, laurea honoris causa and frequent visitor of my university, so that, after I graduated in 1975, I started working under the supervision of *Lamberto Cesari* and I visited the University of Michigan several times. Actually, I was almost adopted by Isotta and Lamberto Cesari. After Cesari's death, I have been among the founding members, of the 'Centro Studi Interfacoltà Lamberto Cesari' at the University of Perugia in 1995.

But my formation as a mathematician was greatly influenced by *James Serrin*, and a very large part of my research life was connected with him. I attended James Serrin's courses beginning with his SAFA IV seminars in Naples in March 1980, but I was introduced to him by *Lamberto Cesari* at the University of Michigan few months later in August 1980 during the conference on the occasion of Cesari's retirement. Professor *Serrin* was already a giant in the subject of partial differential equations, of fluid mechanics, and of thermodynamics. His fundamental contributions, especially in real analysis and in the calculus of variations, were already well known and often cited in Italy since the 1960's. In 1981 *Lamberto Cesari* invited *James Serrin* to the conference held in Bologna to celebrate the 70th birthday of *Cesari* in Italy. On that occasion, during a conversation along Via Zamboni, Lamberto told me to attend the course that James was going to deliver at the SMI school in Cortona, and at the same time asked James to propose to me some topics on which I could report at the summer school. (Presenting such reports was a teaching tool for the young mathematicians at the advanced courses in Cortona.) In August 1981 *James Serrin* and *Lawrence Craig Evans* gave courses at the Cortona summer school, and James gave me some papers on elliptic over–determined problems and on the Mountain

Pass Theorem by *Antonio Ambrosetti* and *Paul Rabinowitz*. This was the starting point of my long fruitful collaboration with James. At that time I was only an assistant professor and in 1983 I got a position as associate professor at the University of Perugia, while in 1987 I became full professor at the University of Modena. James came for frequent visits in both towns, delivering unforgettable exceptional lectures until 2012, when he died.

Since those Cortona lectures, I continued to learn much from him at his remarkable seminars held year after year. I just recall his masterly courses in Milan in 1982 and in Varenna in 1983. James always devoted a surprising amount of time and effort to young mathematicians, giving mathematical consultations even to people unknown to him. Between 1984 and 2012 we wrote more than 40 papers and a monograph on the *The Maximum Principle* together.

In June 2004 the *Accademia Nazionale dei Lincei* awarded the *Prize Prof. Luigi Tartufari for Mathematics* to my research work. The committee, made up by Professors *Enrico Magenes* (President), *Carlo Cercignani*, *Claudio Procesi*, *Sergio Spagnolo* and *Antonio Ambrosetti* (Supervisor), assigned the prize by a detailed report, in which essentially my work with James was quoted. I was very happy and honored, but also James was very glad and proud of me. I will never forget the marvelous words he told me, when I called him and let him know about the prize.

A grateful tribute I desire to address to Professor *Antonio Ambrosetti*, whose guidance, encouragement and achievements will shine brightly on me for ever. Professor *Ambrosetti* was the national coordinator of my Italian team in the MIUR project *Variational Methods and Nonlinear Differential Equations* started by *Ambrosetti* in 1999 and continuously funded by MIUR until its end in 2009. To belong in this team has been being as to be in a warm lovely family, protected and helped in any moment. I organized with Professor *Ambrosetti* the most popular interesting workshops in Perugia and in Grado, full of young clever deep mathematicians. A great unforgettable time.

My long association with *James Serrin* has been for me a wonderful experience and the great master was for me above all a steady friend since I met him in 1980. He was an enthusiastic organizer of the May conference held at Perugia in 2012 on the occasion of my 60th birthday, where several of our best friends and colleagues on PDEs came from all over the world and gave brilliant talks, as Professor *Varga*. The speakers celebrated not only me, but also James, addressing special words to him, with sincere affection and profound esteem. Even though at the time of the conference he was already not well, he attended all the talks and delivered an exceptional and unforgettable opening lecture. His presence in Perugia at the conference was for me the most appreciated gift I received for my 60th birthday.

I wrote jointly with *Vicentiu Radulescu* and *Hans Weinberger* the two–volumes set of the *James Serrin: selected papers*, which appeared in 2014. This experience was for me the most exciting adventure of my mathematical life.

Just last year I received the Doctor Honoris Causa by the University of Craiova and so after this new honor of the Babes-Bolyai University of Cluj-Napoca I feel even closer than ever to Romania.

Magnifice Rector, Dearest Colleagues, Ladies and Gentlemen let me end with my warmest expressions of thanks for the great honor I have to get the Doctor Honoris Causa at the Babes-Bolyai University of Cluj-Napoca and in a country so full of great mathematicians. A country Romania which includes Roma in its name. All of you can imagine what this means for me. Wherever I will go from now on I will say to have received this great honor from the Babes-Bolyai University of Cluj-Napoca and I am really proud to be your ambassador. Thank you very much.

[1] P.P. and J. Serrin, *A general variational identity*, Indiana Univ. Math. J. **35** (1986), 681 - 703.

[2] P.P. and J. Serrin, *Critical exponents and critical dimensions for polyharmonic operators*, J. Math. Pures Appl. **69** (1990), 55 - 83.

[3] P.P. and J. Serrin, *Precise damping conditions for global asymptotic stability for nonlinear second order systems*, Acta Math. **170** (1993), 275 - 307.

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[5] P.P. and J. Serrin, *The strong maximum principle revisited*, J. Differ. Equations, **196** (2004), 1 - 66.