NIT 2011

Natural Information Technologies

Madrid, october 4th – 7th

Organizers

ITHEA International Scientific Society

Universidad Politécnica de Madrid (Spain)

Institute of Mathematics and Informatics, Bulgarian Academy of Sciences (Bulgaria)

Institute of Information Theories and Applications FOI ITHEA (Bulgaria)

Institute for Informatics and Automation Problems, Armenian Academy of Sciences (Armenia)

Association of Developers and Users of Intelligent Systems (Ukraine)

Dorodnicyn Computing Centre of the Russian Academy of Sciences (Russia)

Spanish Network on Biomolecular and Biocellular Computing (Spain)

Conference Venue:

Escuela Universitaria de Informática
Crta. De Valencia Km. 7, 28031 Madrid

http://www.foibg.com/conf/ITA2011/2011nit.htm

NIT 2011

4th - 7th October 2011

PRELIMINARY PROGRAM

Tuesday 4th

15:00 to 17:00 **Registration**

Wednesday 5th

FIRST SESSION – Moderator: Fernando Arroyo Montoro

10:00 – 10:30 **Opening Session**

10:30 – 11:30 Invited Speaker: **Mario de J. Pérez Jimenez**
(Universidad de Sevilla, Spain)

MEMBRANE SYSTEMS: A BIO-INSPIRED COMPUTING MODELLING FRAMEWORK

Membrane systems provide a high level computational modeling framework which integrates the structural and dynamical aspects of biological phenomena in a compressive and relevant way. The inherent randomness, external noise and uncertainty in those phenomena are captured by using stochastic and probabilistic strategies. Rather than being an alternative to more classical modeling frameworks, like ordinary differential equations, membrane systems constitute a complementary approach to be used when the classical modeling approaches fail to specify and simulate certain population's biology correctly. In this talk, a membrane system based general framework for modeling the dynamics of population biology computationally is presented, and some applications to phenomena at micro (quorum sensing) and macro (real ecosystem) levels are described.

11:30 – 12:00 **Coffee break**

12:00 – 13:00 Invited Speaker: **Jose María Sempere**
(Universidad Politécnica de Valencia, Spain)

NETWORKS OF GENETIC PROCESSORS AND PARALLEL GENETIC ALGORITHMS

In this talk we will introduce a new model of computation named Networks of Genetic Processors (NGPs). This model is inspired in two previously proposed ones: Networks of Evolutionary Processors (NEPs) and Networks of Splicing Processors (NSPs). We will show that NGPs are computationally complete (i.e. they are able of accepting any recursively enumerable language and they have the computational power of Turing machines). We will overview some aspects related to the computational and descriptive complexity of the model. Next, we will introduce Parallel Genetic Algorithms and we will propose two different criterions to solve decision problems with these techniques. Then, we will show the correspondence between NEPs and PGAs. Finally, we will show some applications of the proposed model to solve efficiently hard combinatorial problems and some problems related to bioinformatics.

13:00 – 13:45 **Victor Martinez Hernando**

IMPLEMENTATION OF AN NEP IN JAVA

The Networks of Evolutionary Processors (NEPs) are computing mechanisms directly inspired from the behavior of cell populations more specifically the point mutations in DNA strands. These mechanisms are been used for solving NP-complete problems by means of a parallel computation postulation. This paper describes an implementation of the basic model of NEP and includes the possibility of designing some of the most common variants of it by means of a graphic user interface which eases the configuration of a given problem. It is a system designed to be used in a multicore processor in order to benefit from the multi thread use.

Rosario Lombardo, Vincenzo Manca

Milieu-M: VISUAL MANIPULATION AND PROGRAMMING FOR MULTI-MEMBRANES

In the context of membrane computing, the new notion of multi-membrane was introduced where the junction of membranes is used together with the inclusion of membranes. In multi-membranes a deterministic computation model can be defined for computing arithmetical functions by designing a sort of circuits in pure

geometrical forms articulated at different distributed levels.
In this article we present Milieu-M, a software tool for the visual manipulation of calculi on membranes and multi-membranes offering a rich and interactive Graphical User Interface. The visual programming approach is used to create topological forms entirely describing an algorithm in terms of the Pure Graphs formalism. The visual programming formalism and the textual multi-membrane programming language can be used jointly in Milieu-M to work on the same model and for seamlessly generating source code from the visual graphs and vice versa.

13:45 – 15:00 **Lunch**

SECOND SESSION – Moderator: Juan Castellanos

15:00 – 16:00 Invited Speaker: **Pedro Marijuan**
(Universidad de Zaragoza)

COMPUTATIONAL CHALLENGES OF THE EUKARYOTIC CELL

An information revolution took place in cellular systems around 1,200 Mys ago. It was preceded and made possible by an energy revolution derived from the symbiotic capture of mitochondria. Whereas prokaryotes had already made a start towards cellular complexity eukaryotic style, they could not exhibit more than one complex trait at a time, given the energy costs implied. Novel protein folds, protein interactions, and regulatory cascades were required for putting together the isolated complexity traits that bacteria had already explored but in too restricted a way: separate nucleus, dynamic cytoskeleton, endocytosis, linear chromosomes, introns and exons, massive intracellular and intercellular signaling, etc. The evolutionary result was an amazing "computing power" harnessed by the eukaryotic cell, which we can barely analyze yet. In particular, a sophisticate signaling system provided the cell with the capability to encode differentiation and self-construction processes of a whole organism. We will discuss how the signaling system defines and structures the functioning of the cell, and also the "minimal cell concept" applied to eukaryotes. Finally, in the extent to which the living cell can be considered as one of the central paradigms of the nascent information science, this discussion also becomes one about the essential cluster of concepts which should potentially apply to the analysis of other information-based entities.

16:00 – 18:00 **Discussion** ITHEA members

Thursday 6th

FIRST SESSION – Moderator: Luis Fernando Mingo López

10:00 – 11:00 Invited Speaker: **Victor Mitrana**
(Universidad Politécnica de Madrid, Spain)

HAIRPIN LENGTHENING: ALGORITHMIC RESULTS

We consider a new bio-operation inspired by the DNA chemistry called hairpin lengthening. Several algorithmic aspects (decidability, distances, recognition) concerning this operation viewed as a formal operation on strings and sets of strings as well as their complexity, are discussed.

11:00 – 11:30 **Nuria Gómez, Alberto Arteta, Luis Fernando Mingo**

MEIA SYSTEMS: MEMBRANE ENCRYPTED INFORMATION APPLICATIONS SYSTEMS

Membrane computing is a recent area that belongs to natural computing. This field works on computational models based on nature's behavior to process the information. Recently, numerous models have been developed and implemented with this purpose. P-systems are the structures which have been defined, developed and implemented to simulate the behavior and the evolution of membrane systems which we find in nature. What we show in this paper is a new model that deals with encrypted information which provides security tho the membrane systems communication. Moreover we find non deterministic and random applications in nature that are suitable to MEIA systems. The inherent parallelism and non determinism make this applications perfect object to implement MEIA systems.

Chesta Agarwal, Abhilasha Sharma

IMAGE UNDERSTANDING USING DECISION TREE BASED MACHINE LEARNING

Image Understanding, a discipline that concerns the interpretation of an image and analysis of the image to give a decision about the image and the actions represented in it. Decision tree is a tree based classification, widely used in data mining, which classifies the input data set into predefined classes. Decision tree approach is used here

to train the image understanding system to perform supervised machine learning. The various low level characteristic features (color, shape, texture) of the image form the various attributes of the decision tree among others. This paper presents the application of the decision tree approach for image understanding. It also discusses an algorithm to calculate the relative distance between the retrieved results, as a sub process required in the proposed approach. The paper describes the production rules required to generate the decision tree. An example study is used to describe the image understanding process in a descriptive manner.

11:30 – 12:00 Coffee break

12:00 – 13:00 Invited Speaker: **Krassimir Markov**
(Institute of Mathematics and Informatics, BAS, Bulgaria)

A TOOL FOR BUILDING NIT INFORMATION BASES

During the years only one kind of DBMS remain popular – the Relational DBMS (RDBMS). In some applications the relation model is not effective, for instance, working with high dimensional data. For solving this problem another model for organization of information base was introduced long time ago. This is Multi-dimensional Information Model (MDIM). The main its characteristic is using the addressing instead of searching. The main goal of the paper is to discuss possibilities of MDIM for building NIT information bases and corresponded information service. The main features of MDIM are outlined and examples of using it in several application domains are given.

Krassimira Ivanova, Vitalii Velychko, Krassimir Markov, Iliya Mitov

ABOUT MULTI-VARIANT CLUSTERING AND ANALYSIS HIGH-DIMENSIONAL DATA

In this paper an example of multi-variant clustering is presented. The problems to be solved are described and multi-variant clustering based on pyramidal multi-layer multi-dimensional structures is outlined. The conclusion is that the multi-variant clustering combined with pyramidal generalization and pruning gives reliable results.

13:00 – 13:45 Fernando Arroyo, Carmen Luengo, José R. Sánchez

MEMBRANE STRUCTURE SIMPLIFICATION

Idempotent operators are one of the possible criterions for simplification trees. These operators act over internal nodes of trees. Moreover, they transform structural equivalent sub-trees, which have the same root into a single copy. This copy will be placed into the common root reducing –simplifying- the tree.
This process can be also applied to membrane structures; in this case idempotent operator will be applied to non elementary membranes, and the process will produce the simplest possible membrane structure. The main idea of this work is to apply this kind of operator to binary membrane structures to identify possible recurrent sub-trees and to study possible application of this concept to hardware design implementations.

Kiran mayee

PurposeNet : A SEMANTIC KNOWLEDGEBASE

PurposeNet is a semantic knowledgebase of artifacts, developed with purpose *as the underlying principle of design. The principle is based on the observation that human beings tend to not only organize and categorize physical entities around them intuitively based on purpose, but, the morphology, anatomy and physiology of an artifact as well as its relations with the other artifacts around it are purpose-based. This paper presents the architecture and design of the PurposeNet knowledgebase, with case studies. It also presents a comparative study of the currently popular ontologies with PurposeNet. Some applications using PurposeNet are also dealt* with.

Rafael Lahoz Beltra

CELLULAR COMPUTING: TOWARDS AN ARTIFICIAL CELL

At present most point of views are in agreement with the idea that the similarity between cells and computers is a useful metaphor from which to obtain powerful predictions about life. In this paper we suggest that the analogy between computers and cells should be carefully reviewed when creating a silico artificial cell or whole-cell simulation, avoiding some common misconceptions derived from Cybernetics and the study of biological information processing based on a 'hardware + software' dualism.

13:45 – 15:00 Lunch

SECOND SESSION – Moderator: Rafael Lahoz Beltra

15:00 – 16:00 Invited Speaker: **Alfonso Ortega**
(Universidad Autónoma de Madrid)

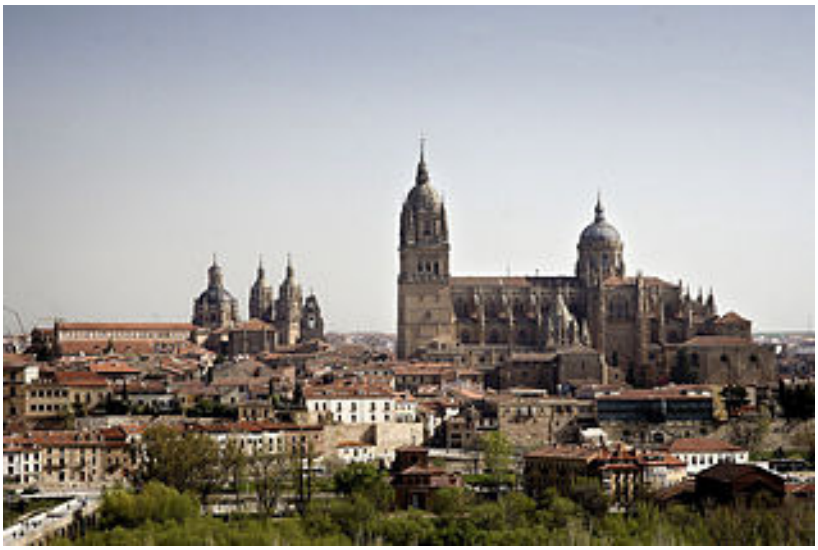
NEPs AS 'REAL COMPUTERS'

A great deal of research effort is currently being made in the realm of so called "natural computing". "Natural computing" mainly focuses on the definition, formal description, analysis, simulation and programming of new models of computation (usually with the same expressive power as Turing Machines) inspired by Nature, which makes them particularly suitable for the simulation of complex systems. NEPs are one of these models. There are two main areas in which NEPs could be useful: as new architectures for computers, other than von Neumann's machine; and as modeling tools to simulate complex systems for which "conventional approaches" (usually based on differential equations) are, in practice, difficult to handle. Two steps are needed in both scenarios:
1. Design a particular instance of the model able to solve the task under study (this step is equivalent to "programming" the model) and
2. "Run" the model but, unfortunately there are no real computers for NEPs and they have to be simulated on conventional platforms.
One of the most interesting features of these bio-inspired computers is their intrinsic parallelism. We can design algorithms for them that could improve the exponential performance of their classic (von Neumann) versions. Nevertheless, when the models have to be simulated on conventional computers, the total amount of space needed to simulate the model and to actually run the algorithm usually becomes exponential. This may be one of the main reasons why natural computers are not widely used to solve real problems. Most of the simulators are not able to handle the size of non trivial problems. Grid, cloud computation and clusters offer an interesting and promising option to overcome the drawbacks of both solutions: "specific" hardware and simulators run on von Neumann's machines.
One of the current topics of interest of our research group is the development of programming tools for NEPs in order to provide the researchers with the same kind of development platforms they can access for other programming paradigms (textual and visual programming languages, compilers that generate code to efficiently run them on different hardware platforms, software engineering tools, etc.)

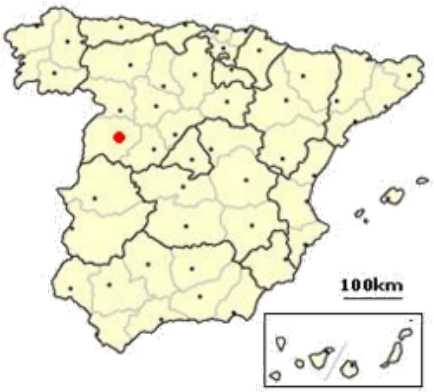
16:00 - 16:30 **Closing Session**

Friday 7th

8:00 **Trip to Salamanca**



View of Salamanca



Location of Salamanca in Spain

Salamanca is a city in western Spain, in the community of Castile and León. Because it is known for its beautiful buildings and urban environment, the Old City was declared a UNESCO World Heritage Site in 1988. It is the most important university city in Spain and is known for its contributions to the teaching of the Spanish language.[1] Salamanca supplies 16% of Spain's market[2] and attracts thousands of international students,[3] generating a diverse multicultural environment.

It is situated approximately 200 km (120 mi) west of Madrid and 80 km (50 mi) east of the Portuguese border. The University of Salamanca, which was founded in 1218, is the oldest university in Spain and the third oldest western university. With its 30,000 students, the university is, together with tourism, the economic engine of the city. Salamanca is the capital of the province of Salamanca, which belongs to the autonomous community of Castile and León (Castilla y León). With a metropolitan population around 192,000 it is the second most populated urban area in Castile and León, after Valladolid (369,000), and closely followed by Leon (187,000) and Burgos (176,000).

History

The city was founded in the pre-Ancient Rome period by the Vacceos, a Celtic tribe, as one of a pair of forts to defend their territory near the Duero river. In the 3rd century BC, Hannibal laid siege to the city. With the fall of the Carthaginians to the Romans, the city of Helmantica, as it was known, began to take more importance as a commercial hub in the Roman Hispania due to its favorable location. Salamanca lay on a Roman road, known as the Vía de la Plata, which connected it with Emerita Augusta (present day Mérida) to the south and Asturica Augusta (present-day Astorga) to the north. Its Roman bridge dates from the first century, and was a part of this road.

With the fall of the Roman Empire, the Alans established in Lusitania, and Salamanca was part of this region. Later the city was conquered by the Visigoths and included in their territory. The city was a already an episcopal see, and signatures of bishops of Salamanca are found in the Councils of Toledo.

Salamanca surrendered to the Moors, led by Musa bin Nusair, in the year 712 AD. For years this area between the south of Duero River and the north of Tormes River, became the main battlefield between the Christian kingdoms and the Muslim Al-Andalus rulers. The constant fighting of the Kingdom of León first, and the Kingdom of Castile and León later against the Caliphate depopulated Salamanca and reduced it to an unimportant settlement. After the battle of Simancas (939) the Christians resettled this area. After the capture of Toledo by Alfonso VI of León and Castile in 1085, the definitive resettlement of the city took place. Raymond of Burgundy, instructed by his father-in-law Alfonso VI of León, led a group of settlers of various origins in 1102.

One of the most important moments in Salamanca's history was the year 1218, when Alfonso IX of León granted a royal charter to the University of Salamanca, while formal teaching had existed at least since 1130. Soon it became one of the most significant and prestigious academic centres in Europe.

During the XVI century the city reached its medieval splendor (around 6,500 students and a total population of 24,000). During that period the University of Salamanca hosted the most important intellectuals of the time, these groups of mostly-dominicans scholars were designated the School of Salamanca. The juridical doctrine of the School of Salamanca represented the end of medieval concepts of law, and founded the fundamental body of the ulterior European law and morality concepts, including rights as a corporeal being (right to life), economic rights (own property) and spiritual rights (freedom of thought and to human dignity).

In 1551 the Holy Roman Emperor Charles V ordered an inquiry to find out if the science of Andreas Vesalius, physician and anatomist, was in line with the Catholic doctrine. Vesalius came to Salamanca that same year to appear before the board and was acquitted.

Salamanca suffered the general decadency of the Kingdom of Castile during the XVII century, but in the XVIII century it had a new reborn. In this period the new baroque Cathedral and main square (Plaza Mayor) were finished.

In the Peninsular War of the Napoleonic campaigns, the Battle of Salamanca, fought July 22, 1812, was a serious setback for the French, and a mighty setback for Salamanca, whose western quarter was seriously damaged. The battle which raged that day is famous as a defining moment in military history; many thousands of men were slaughtered by cannon fire in the space of only a few short hours.

During the devastating Spanish Civil War (1936-9) the city quickly went over to the Nationalist side and was temporarily used as a capital. The Nationalists soon moved their capital to Burgos, which being larger and more central was better suited for this purpose. Like much of fervently Catholic and largely rural Castille, Salamanca was a staunch supporter of the Nationalist side and Francisco Franco's regime for its long duration.
In 1988 the old city was declared UNESCO World Heritage Site. In 1998 it was declared European Capital of Culture for year 2002 (shared with Bruges). During 14 and 15 October 2005 it hosted the XV the Ibero-American Summits of Heads of State and Governments.
Since 1996 Salamanca has been the designated site of the archive of the Spanish Civil War (*Archivo General de la Guerra Civil Española*). The original documents were assembled by the Francoist regime, selectively obtained from the administrative departments of various institutions and organizations during the Spanish Civil War as a repressive instrument used against opposition groups and individuals.[4] The socialist government moved the Catalan part of the archive to Barcelona in 2006 despite opposition from the local authorities and popular protests.

Squares and public spaces

- La **Plaza Mayor**: of Baroque style, designed by architects Alberto and Nicolás Churriguera is the most important of public spaces and the heart of the city.
- **Campo de San Francisco**: First public garden in the city on grounds of the former convent of San Francisco Real.
- **Huerto de Calixto y Melibea**: Garden near to the cathedrals where, some say, lies the plot of the novel *La Celestina* by Fernando de Rojas. Besides it are remains of the Roman Walls.
- **Plaza del Corrillo**: Small square adjacent to the Plaza Mayor. On the left is the Romanesque church of San Martín and the right a series of houses with porches formed by columns of stone completed in pads representing the days of the week (a moon for the Monday, a Mars for Tuesday, etc.).

Religious buildings

- **Capilla de la Vera Cruz**: Baroque church with Renaissance facade, headquarters of the five hundred year old Brotherhood of the Vera Cruz of Salamanca. It houses countless works of art.
- Cathedrals: Salamanca has two cathedrals, the **Old Cathedral**, of the 12th century and of Romanesque style, and the **New Cathedral**, much larger, built in 16th century of Gothic style and completed in 18th century. The place where it join both is known as Patio Chico and is one of the most charming corners of the city.
- **La Clerecía**: currently houses the Pontifical University. Building started in 1617 and was completed 150 years later as the Colegio Real del Espíritu Santo, of the Society of Jesus. The style is Baroque. It difference the school, with an interesting cloister and the church, with an impressive facade of three bodies, two twin towers of 50 meters high and a huge dome. The Clerecía name is because it belonged to the Real Clerecía de San Marcos after the expulsion of the Jesuits.
- **Colegio de Calatrava** : Built in 18th century, by initiative of the Order of Calatrava, now houses the Casa de la Iglesia.
- **Convento de las Agustinas e Iglesia de la Purísima**: In the church is a painting of the Immaculate Conception painted by Jusepe de Ribera. It is the only construction of totally Italian space and decor in Spain.
- **Convento de las Dueñas** (15th century): Highlights the irregular Renaissance cloister.
- **Convento de las Isabeles**
- **Convento de San Antonio el Real** (1736): de estilo barroco, of Baroque style, its remains were divided between the Lyceum Theatre and a store where it can visit.

- **Convento de San Esteban**, of the Dominican fathers (16th century): the plateresque facade, with its shape of arc of triumph, is a jewel of the Salamancan Renaissance. Impressive Baroque altarpiece by José Benito Churrriguera. Also noteworthy is the Cloister of the Kings, Renaissance.
- **Convento de la Anunciación** (called de las Úrsulas): Founded by the Archbishop Fonseca in 1512. Stresses the exterior apse of Gothic style. In the inside, the Baroque altarpiece and the tomb of the founder, Renaissance, work by Diego Siloe.
- **Convento de la Trinidad**: Former Palacio de Montellano adapted in 16th century to host a Trinitarian convent.
- **Monasterio de Nuestra Señora de la Victoria**, of the Order of St. Jerome, completed in 1513, almost destroyed by the French in the early 19th century, the Peninsular War, is now integrated into the manufacturing facilities of the 19th century, of the Grupo Mirat.
- **Ermita de Nuestra Señora de la Misericordia** (16th-17th centuries): small Baroque hermitage was begun in 1389 in the Plaza de San Cristobal. Currently very damaged, is a printing, while its bell-gable decorates the church of the Pizarrales neighborhood.
- **Antigua iglesia de las Bernardas** work by Rodrigo Gil de Hontañón. Prototype of the Salamancan churches of the 16th century. Stresses the shell-shaped head. Today it is within the colegio de San José de Calasanz.
- **Iglesia del Carmen de Abajo**: Chapel of the Third Order of Caramel integrated in the Convent of San Andrés. It is the only remainder from that referred convent disappeared in 19th century.
- **Iglesia de San Benito**: Gothic church built under the patronage of Alonso II de Fonseca, pantheon of the Maldonado family.
- **Iglesia de San Julián**: Romanesque church subsequently restored.
- **Iglesia de San Marcos**: Romanesque church near the path which ran the North walls of the city. Outside cicular plant has three naves and apses inside.
- **Iglesia de San Martín**: Romanesque church with Gothic reforms, Renaissance and Baroque, attached to the Plaza Mayor.
- **Iglesia de San Pablo**: Baroque church belonging to the former convent of the Trinitarians, houses the image of Jesus Rescued, much venerated in the city. Parish hosts, governed by the Diocesan Laborer Priests.
- **Iglesia de Santo Tomás Cantuariense**: Romanesque church founded in honor of St. Thomas, Archbishop of Canterbury in 1175, just five years after his death and two after his canonization. It has three apses and a nave with a wooden roof. Form Parish along with St. Paul, governed by the Diocesan Laborer Priests.

University

In 1218, Alfonso IX of León founded the University of Salamanca. Under the patronage of the learned Alfonso X, its wealth and reputation greatly increased (1252–1282), and its schools of canon law and civil law attracted students even from the Universities of Paris and Bologna.[*when?*] In the 16th century, the city's fortunes depended on those of the university. About the time Christopher Columbus was lecturing there on his discoveries, Hernán Cortés took classes at Salamanca, but returned home in 1501 at age 17, without completing his course of study. (About ten years later the *conquistador* Francisco Vásquez de Coronado was born in Salamanca.)

It was scholars of the University such as Francisco de Vitoria who, heavily influenced by the Paris-based Scottish philosopher John Mair, helped design in 1512 the Laws of Burgos which established the right to life and liberty of the indigenous peoples of America.

Ignatius Loyola, while studying at Salamanca in 1527, was brought before an ecclesiastical commission on a charge of sympathy with the Illuminati, but escaped with an admonition. In the next generation St. John of the Cross studied at Salamanca and so did the poet and writer Mateo Aleman. Miguel de Unamuno was a prominent figure of the university in more modern times.

Many people continue to come from all parts of Spain to study at the University, and the students represent a significant percentage of the city's population (the University has 36,000 students, approximately).

University buildings

- University: Set of buildings that made up the former University of Salamanca, including the **Escuelas Mayores**, the **Escuelas Menores** and the **Hospital de Estudio** (current rectorate). These buildings are situated around the square known as Patio de Escuelas. In this same square is the home of Dr. Álvarez Abarca or of the Doctors of the Queen (15th century), whose facade is Gothic with Renaissance details and is now the Museum of Salamanca.
- **Casa-museo de Unamuno** (18th century): former home of the rectors of the university. It preserved as in its time it had Miguel de Unamuno when he took this position.
- **Colegio Mayor de Santiago el Zebedeo**, also called "of the Archbishop Fonseca" or "of the Irish" (16th century).
- **Colegio de San Ambrosio** (1719): Is currently General Archive of the Spanish Civil War. Houses documents and items seized by the national troops and their allies during and at the end of the Spanish Civil War. While over the entire postwar its basic objective was to preserve the information related to organizations and peoples potentially opposing the Franco regime, and therefore use this information for repressive, since the return of democracy this building would become one of the most important archives that existed in Spain to investigate the historical period of the Second Republic. Many of the documents and objects that still remain in the archive are related to the Freemasonry, including several furniture that has been rebuilt a Masonic Lodge.
- **Colegio Trilingüe**: founded in 1554 to the teaching of Latin, Greek and Hebrew. It also preserves part of the original courtyard, remade in 1829, in the Faculty of Physics.
- **Palacio de Anaya** was the last headquarters of the Colegio Mayor de San Bartolomé or **Colegio de Anaya** founded in 15th century by Don Diego de Anaya, abolished in the early 19th century. Today is the faculty of philology. Next to the building is the iglesia of San Sebastian, former chapel of the college and the Inn, work by Joaquín de Churriguera.
- **Colegio Santa Cruz de Cañizares** (16th c.): Music Conservatory. Of it only remains the old chapel, now incorporated into the assembly hall of the conservatory, and the main facade, of plateresque style.
- **Colegio de San Pelayo**: founded in the mid 16th century. Since 1990 home to the Faculty of Geography and History.

Palaces and palatial houses

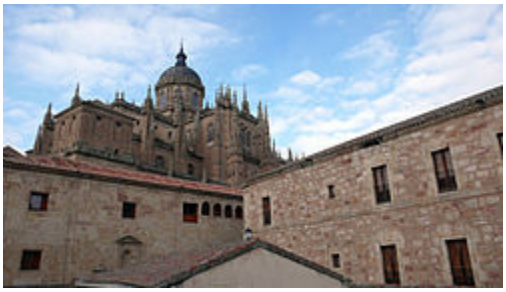
- **Casa de las Conchas**: built in the late 15th century. of Gothic civil style, its facade is decorated with about 350 shells of scallops, distinctive of the Order of Santiago. Also important are the bars Gothic windows. It currently houses a public library.
- **Casa de Don Diego Maldonado**: 16th century Platereque palace. It houses the Hispanic-Brazilian Cultural Foundation and the Centre for Brazilian Studies at the University of Salamanca.
- **Casa de doña María la Brava**: 15th century Gothic building, prototype of the noble mansions of the time. Its owner, María Rodríguez de Monroy was the head of one of the two sides in that split the city in the 15th century. Beheaded the murderers of her children. It is located in the Plaza de los Bandos.
- **Casa Lis**: Modernist palace of 1905 with iron facade. Built on the walls. It houses the collections of Art Nouveau and Art Deco donated by Manuel Ramos Andrade. .
- **Casa de las Muertes** (early 16th century), built by Juan de Álava and named such for the skulls that decorate the facade.
- **Casa del Regidor Ovalle** (18th century): in this died Miguel de Unamuno.
- **Casa de Santa Teresa** (16th century): The saint Teresa of Ávila stayed here when she visited Salamanca in 1570 to found a convent and here she wrote the poem *Vivo sin vivir en mí*.
- **Casa de la Tierra** (15th century): doorway with arched, Gothic window tracery. Headquarters of the Chamber of Commerce and Industry of Salamanca.
- **Casa de las Viejas** (17th century): old workhouse for poors, now the headquarters of the Regional Film Archive of Castile and León. Permanent exhibition of equipment related to cinema and its history, owned by Salamancan filmmaker Basilio Martín Patino.
- **Fonda Veracruz** : courtyard with wooden galleries in form of dead-end street. Currently catering school.
- **Arias Corvelle Palace** (15th century): sgraffito facade very similar to that of San Boal. It houses the School of Fine and Performing Arts of San Eloy.

- **Castellanos Palace** (15th-16th centuries): The Palace of the Marquises of Castellanos construction began in the late 15th century, although the facade dates from the late 19th due which combines Gothic and Neoclassical styles. With a powerful Gothic interior courtyard, this building now serves as a hotel.
- **Garci Grande Palace** (16th c.): Renaissance doorway and chamfered corner windows unique in the city. Head Office of the Savings Bank (Caja Duero).
- **Monterrey Palace**: was built in the 16th century and is of plateresque style. Belongs to the House of Alba and highlight its towers and chimneys. Only it built one of the four parts that composed all designed initially.
- **Orellana Palace** (16th c.): building of classical architecture with Mannerist inflence. The courtyard in *L* shape and the ladder.
- **Rodríguez de Figueroa Palace** (1545): has interesting facades at the streets Concejo and Zamora and interior courtyard. Today the Salamanca Casino.
- **La Salina Palace** (1546): Renaissance, work by Rodrigo Gil de Hontañón. Since 1884 is the headquarters of the Provincial Diputation.
- **San Boal Palace** (15th c.): facade decorated with sgraffitos. Was School of Commerce and later Faculty of Business. Since 1999 is Hispanic-Japanese Cultural Center of the University of Salamanca. In the same square is the Iglesia de San Boal (17th c.).
- **Solís Palace** (15th c.): In this palace were married Philip II of Spain and Maria Manuela of Portugal in 1543. Today it houses the Telefónica.
- **Tower del Aire**: is all that remains of the Palace of the dukes of Fermoselle, built in the 15th century. It has beautiful Gothic windows. It is currently a student residence.
- **Tower del Clavero** (15th c.): remains of a palace, apparently built by Francisco de Sotomayor, Clavero Staff of the Order of Alcántara, about 1470 . The lower part is quadrangular, while the upper is octagonal adorned with eight cylindrical turrets.
- **Torreón de los Anaya** (15th c.): old manor house of Gothic civil style which highlights the mullioned window and the patio de tres lados. For years it was the seat of Institute of Studies of Latin America and Portugal of the University of Salamanca, also known as Palacio de Abrantes.

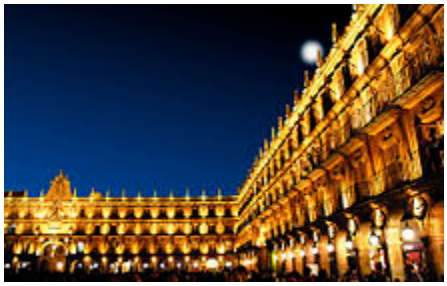
Museums

- **Art Nouveau and Art Deco Museum. Casa Lis**
- **Museum of the History of the City**
- **Museum of the Trade of Salamanca**
- **Casa Museo Unamuno**
- **Museum of Automotive History of Salamanca**
- **Museum of Salamanca**
- **Cathedral Museum**
- **Museum of the Convento de San Esteban**
- **University Museum - University Library**
- **University Collections**
- **Bullfighting Museum**
- **Collections of the Convento de las Úrsulas**
- **Museum of the Convento de Santa Clara**
- **Teresian Museum**
- **Casa Museo de Zacarías González**. House where Zacarías González lived and painted, on the street Alarcón.
- **Permanent Exhibition IERONIMUS**. The name of the exhibition: IERONIMUS alludes to Don Jerónimo de Périgueux, famed French-born Spanish bishop by the Diocese of Salamanca in 1102, who was commissioned the construction of the Iglesia de Santa María.

Gallery

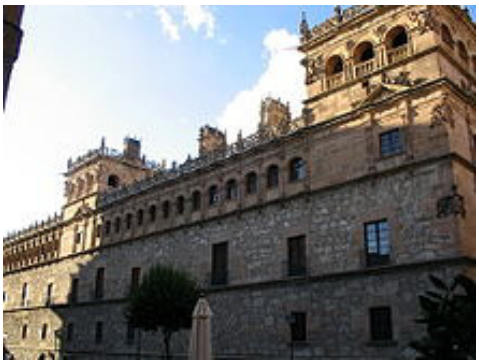


Old City of Salamanca

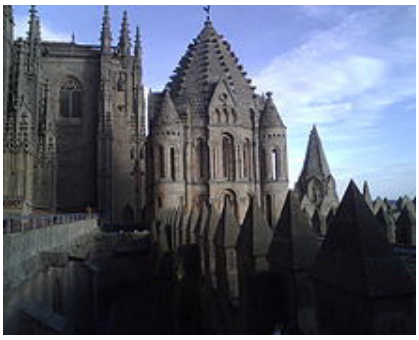


Plaza Mayor

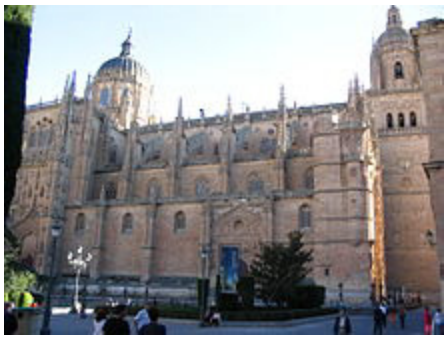
Exterior of the Art Nouveau
and Art Deco Museum. Casa Lis.



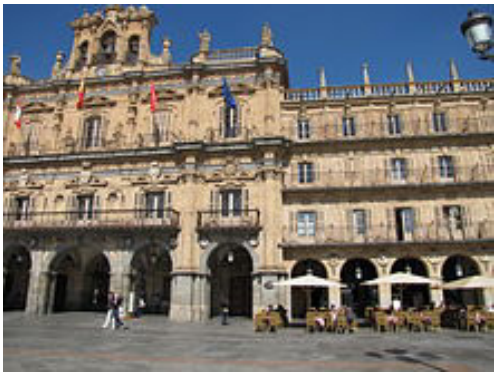
Monterrey Palace (16th century)



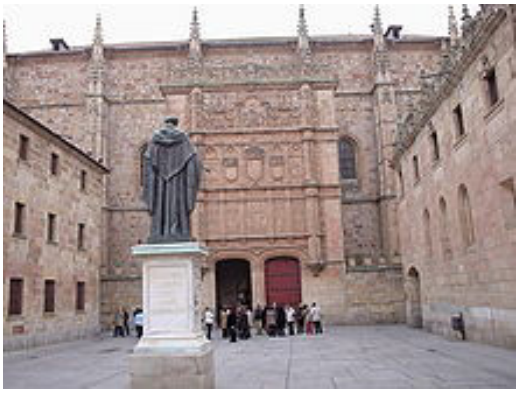
Old Cathedral, Salamanca,
built in the 12th century



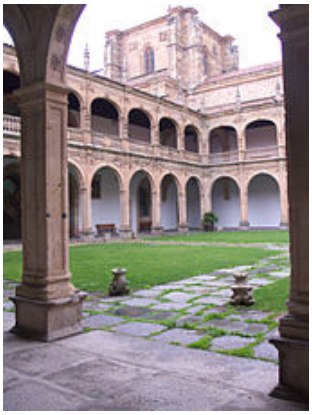
New Cathedral of Salamanca,
built in the 16th century



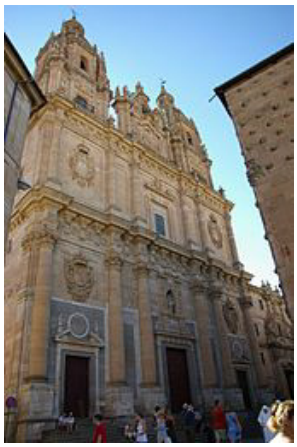
The city hall of Salamanca near the terrace of the Café Novelty founded in 1905.



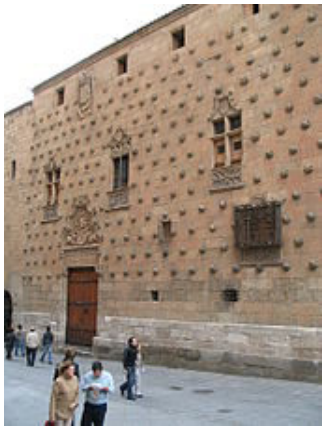
Plateresque facade of the University of Salamanca.



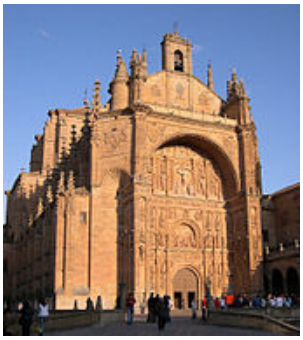
Colegio Mayor de Santiago el Zebedeo (old Irish College).



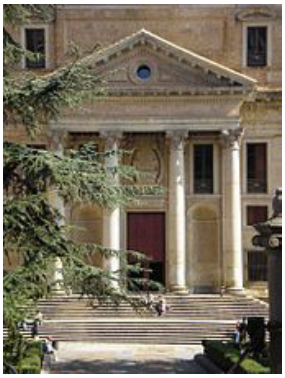
Facade of the church of La Clerecía.



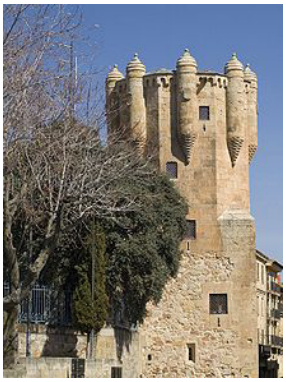
Casa de las Conchas *(House of the Shells)*



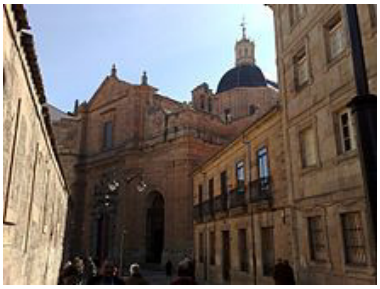
Convento de San Esteban (16th century)



Palacio de Anaya

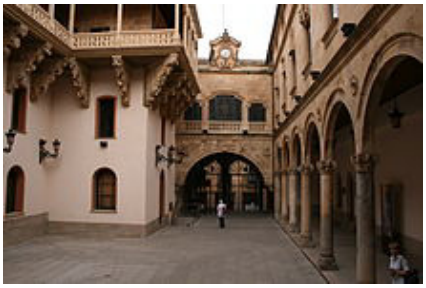


Tower del Clavero (15th century)



Convento de las Agustinas e Iglesia de la Purísima

A street of the old city



La Salina Palace