

**San Pablo Catholic University (UCSP)**  
**Undergraduate Program in**  
**Computer Science**  
**SILABO**



**CS312. Advanced Data Structures (Mandatory)**

**1. General information**

1.1 School	:	Ciencia de la Computación
1.2 Course	:	CS312. Advanced Data Structures
1.3 Semester	:	6 <sup>to</sup> Semestre.
1.4 Prerequisites	:	CS212. Algorithm Analysis and Design. (5 <sup>th</sup> Sem)
1.5 Type of course	:	Mandatory
1.6 Learning modality	:	Face to face
1.7 Horas	:	2 HT; 4 HP;
1.8 Credits	:	4
1.9 Plan	:	Plan Curricular 2016

**2. Professors**

**Lecturer**

- Erick Gomez Nieto <emgomez@ucsp.edu.pe>
  - PhD in Ciencia de la Computación y Matemática Computacional, Universidad de Sao Paulo - USP, Brasil, 2017.
  - MSc in Ciencia de la Computación, Universidad de Sao Paulo - USP, Brasil, 2012.

**Practice**

- Carlos Eduardo Atencio Torres <ceatencio@ucsp.edu.pe>
  - MSc in Ciencia de la Computación, USP, Brasil, 2014.

**3. Course foundation**

Algorithms and data structures are a fundamental part of computer science that allow us to organize information more efficiently, so it is important for every professional in the area to have a solid background in this regard.

In the course of advanced data structures our goal is for the student to know and analyze complex structures, such as Multidimensional Access Methods, Spatio-Temporal Access Methods and Metric Access Methods, Compact Data Structures, etc.

**4. Summary**

1. Técnicas Básicas de Implementación de Estructuras de Datos 2. Métodos de Acceso Multidimensionales 3. Métodos de Acceso Métrico 4. Métodos de Acceso Aproximados 5. Seminarios

**5. Generales Goals**

- That the student understands, designs, implements, applies and Propose innovative data structures to solve problems related to the handling of multidimensional data, retrieval of information by similarity, search engines and other computational problems.

## 6. Contribution to Outcomes

This discipline contributes to the achievement of the following outcomes:

- 1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions. (**Usage**)
- 2) Design, implement and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline. (**Familiarity**)
- 6) Apply computer science theory and software development fundamentals to produce computing-based solutions. (**Familiarity**)

## 7. Content

### UNIT 1: Técnicas Básicas de Implementación de Estructuras de Datos (16)

#### Competences:

##### Content

- Structured Programming
- Object-oriented programming
- Abstract Data Types
- Independence of the user programming language of the structure
- Platform Independence
- Concurrency control
- Data Protection
- Encapsulation levels (struct, class, namespace, etc)

##### Generales Goals

- That the student understands the basic differences that involve the different techniques of implementation of data structures[Usage]
- That the student analyze the advantages and disadvantages of each of the existing techniques[Usage]

**Readings:** Cuadros-Vargas et al. (2004), Knuth (2007a), Knuth (2007b), Gamma et al. (1994), Björnander (2018), David Vandevorde (2018)

### UNIT 2: Métodos de Acceso Multidimensionales (16)

#### Competences:

##### Content

- Access Methods for Point Data
- Access Methods for non-point data
- Problems with dimension enhancement

##### Generales Goals

- That the student understands to know and implement some Access Methods for multidimensional data and temporal space[Usage]
- That the student understands the potential of these Access Methods in the future of commercial databases[Usage]

**Readings:** Samet (2006), Gaede and Günther (1998)

UNIT 3: Métodos de Acceso Métrico (20)	
Competences:	
Content	Generales Goals
<ul style="list-style-type: none"> <li>• Metric Access Methods for discrete distances</li> <li>• Metric Access Methods for Continuous Distances</li> </ul>	<ul style="list-style-type: none"> <li>• That the student understands to know and implement some methods of metric access[Usage]</li> <li>• That the student understands the importance of these Access Methods for Information Retrieval by similarity[Usage]</li> </ul>
<b>Readings:</b> Samet (2006), Chávez et al. (2001), Traina Jr et al. (2000), Zezula et al. (2007)	

UNIT 4: Métodos de Acceso Aproximados (20)	
Competences:	
Content	Generales Goals
<ul style="list-style-type: none"> <li>• Space Filling Curves</li> <li>• Locality Sensitive Hashing</li> </ul>	<ul style="list-style-type: none"> <li>• That the student understands to know and implement some approximate access methods[Usage]</li> <li>• That the student understands the importance of these Access Methods for Information Retrieval by Similarity in environments where Scalability is a very important factor [Usage]</li> </ul>
<b>Readings:</b> Samet (2006), PGregory Shakhnarovich and Indyk (2006), Zezula et al. (2007)	

UNIT 5: Seminarios (8)	
Competences:	
Content	Generales Goals
<ul style="list-style-type: none"> <li>• Access Methods Temporary Space</li> <li>• Generic Data Structures</li> </ul>	<ul style="list-style-type: none"> <li>• That the student can discuss the latest advances in access methods for different domains of knowledge [Usage]</li> </ul>
<b>Readings:</b> Samet (2006), Navarro (2016), Chávez et al. (2001)	

#### 8. Methodology

1. El profesor del curso presentará clases teóricas de los temas señalados en el programa propiciando la intervención de los alumnos.
2. El profesor del curso presentará demostraciones para fundamentar clases teóricas.
3. El profesor y los alumnos realizarán prácticas
4. Los alumnos deberán asistir a clase habiendo leído lo que el profesor va a presentar. De esta manera se facilitará la comprensión y los estudiantes estarán en mejores condiciones de hacer consultas en clase.

#### 9. Assessment Theory Sessions:

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

#### Practical Sessions:

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

#### Evaluation System:

The final grade is obtained through of:

CONTINUOUS ASSESMENT	EVALUATIONS
<b>Continuous assessment 1</b> : 20 %	<b>Midterm Exam</b> : 20 %
<b>Continuous assessment 2</b> : 20 %	<b>Final Exam</b> : 40 %
40%	60%

Where:

Continuous Assessment: It includes group work, active participation in class, exercise test.

- Continuos assessment 1 (weeks 1 - 9)
- Continuos assesment 2 (weeks 10 - 17)

To pass the course you must obtain 11.5 or more in the final grade .

## References

- Björnander, Stefan (Feb. 2018). *C++17 By Example: Practical projects to get you up and running with C++17*. Packt Publishing.
- Chávez, E. et al. (Sept. 2001). “Proximity Searching in Metric Spaces”. In: *ACM Computing Surveys* 33(3), pp. 273–321.
- Cuadros-Vargas, Ernesto et al. (2004). “Implementing data structures: An incremental approach”. <http://socios.spc.org.pe/ecuadros/cursos/pdfs/>.
- David Vandevoorde Nicolai M. Josuttis, Doug Gregor (Sept. 2018). *C++ Templates: The Complete Guide*. Addison-Wesley Professional.
- Gaede, Volker and Oliver Günther (1998). “Multidimensional Access Methods”. In: *ACM Computing Surveys* 30(2), pp. 170–231.
- Gamma, Erich et al. (Nov. 1994). *Design Patterns: Elements of Reusable Object-Oriented Software*. Computing Series. ISBN-10: 0201633612. Addison-Wesley Professional.
- Knuth, Donald Ervin (Feb. 2007a). *The Art of Computer Programming, Fundamental Algorithms*. 3rd. Vol. I. 0-201-89683-4. Addison-Wesley.
- Knuth, Donald Ervin (Feb. 2007b). *The Art of Computer Programming, Sorting and Searching*. 2nd. Vol. II. 0-201-89685-0. Addison-Wesley.
- Navarro, Gonzalo (2016). *Compact Data Structures*. Cambridge University Press. ISBN: 978-1107152380.
- PGregory Shakhnarovich, Trevor Darrell and Piotr Indyk (Mar. 2006). *Nearest-Neighbor Methods in Learning and Vision: Theory and Practice*. 1st. ISBN 0-262-19547-X. MIT Press.
- Samet, Hanan (Aug. 2006). *Foundations of Multidimensional and Metric Data Structures*. Illustrated. Elsevier/Morgan Kaufmann. ISBN: 9780123694461.
- Traina Jr, C. et al. (Mar. 2000). “Slim-Trees: High Performance Metric Trees Minimizing Overlap between Nodes”. In: *Advances in Database Technology - EDBT 2000, 6th International Conference on Extending Database Technology*. Vol. 1777. Lecture Notes in Computer Science. Springer: Konstanz, Germany, pp. 51–65.
- Zeuzula, Pavel et al. (Nov. 2007). *Similarity Search: The Metric Space Approach*. 1st. ISBN-10: 0387291466. Springer.