

PROGRAMA DE CURSO

Código	Nombre			
IN7609	Fixed-parameter algorithms			
Nombre en Inglés				
Fixed-parameter algorithms				
SCT	Unidades Docentes	Horas de Cátedra	Horas Docencia Auxiliar	Horas de Trabajo Personal
6	10	3	1.5	5
Requisitos			Carácter del Curso	
IN3701 or (alternatively) MA3701 or (alternatively) CC3001 or AUTOR			Electivo de Carrera, Magister y Doctorado.	
Competencias a las que tributa el curso				
The student knows techniques for constructing fixed-parameter algorithms for optimization problems, in particular for NP-hard problems, and knows how to apply them to a new problem. Moreover, he knows techniques to show that a problem most likely does not admit a fixed-parameter algorithm, i.e., that it is W[1]-hard.				
Propósito del curso				
Many optimization problems are NP-hard and therefore one does not expect to find an efficient algorithm for them, i.e., an algorithm with polynomial running time. In this class the students learn techniques to design algorithms for such problems that are fast and still produce good solutions.				
If a problem is NP-hard we do not expect to find an algorithm that solves <i>all</i> its possible instances efficiently. However, it might be that there are large classes of instances that can be solved quickly. In this course we study <i>fixed-parameter algorithms</i> which are intuitively algorithms for NP-hard problems that run provably quickly on certain instances. For such an algorithm we measure the difficulty of any given instance by some parameter k . Intuitively, if k is small then the instance is easy and if k is large then the instance is difficult and we want an algorithm that is fast for instances where k is small. A fixed-parameter algorithm then has a running time of the form $f(k)n^{O(1)}$ for some function f which in particular means that it runs in polynomial time if k is a constant. In this class, we will see many of the known techniques for designing such an algorithm. In particular, many of these techniques are preprocessing routines that reduce the size of the given instance and that can be used together with any computational method, e.g., when solving an instance using Gurobi.				

Resultados de Aprendizaje

RA1: Knowledge of the formal definitions of fixed parameter tractability (FPT), kernelization, bounded search trees, iterative compression, randomized methods, and treewidth

RA2: Knowledge of parametrized reductions, the W-hierarchy, some $W[1]$ - and $W[2]$ - complete problems, lower bounds based on the Exponential Time Hypothesis (ETH).

Metodología Docente	Evaluación General
<p>The class is based on active participation of the students, among the strategies for this are</p> <ul style="list-style-type: none"> • problem based learning • regular assignments • interactive classes 	<p>The students are evaluated continuously during the semester via</p> <ul style="list-style-type: none"> • homeworks • a mid-term exam • A final exam.

Unidades Temáticas

Número	RA al que tributa	Nombre de la Unidad	Duración en Semanas
1	RA1 and RA2	Introduction	1
Contenidos		Resultados de Aprendizajes de la Unidad	Referencias a la Bibliografía
<ul style="list-style-type: none"> Introduction of fixed-parameter algorithms 		The student understands the definitions of fixed-parameter algorithms and understands why the given examples fulfill definitions.	[1] chapter 1
Número	RA al que tributa	Nombre de la Unidad	Duración en Semanas
2	RA1	Fixed-parameter algorithms	11
Contenidos		Resultados de Aprendizajes de la Unidad	Referencias a la Bibliografía
<ul style="list-style-type: none"> Formal definitions of fixed parameter tractability (FPT) Kernelization Bounded search trees Iterative compression Randomized methods Treewidth Matroids 		The student understands the algorithmic techniques taught in class. He is able to apply them to similar problems and to design new fixed-parameter algorithms for them.	[1] parts I+II
Número	RA al que tributa	Nombre de la Unidad	Duración en Semanas
3	RA2	Fixed-parameter intractability	4
Contenidos		Resultados de Aprendizajes de la Unidad	Referencias a la Bibliografía
<ul style="list-style-type: none"> Parametrized reductions The W-hierarchy W[1]-complete problems Lower bounds based on the Exponential Time Hypothesis 		The student understands that there are problems that are most likely not fixed-parameter tractable. He can prove that this the case for a given new problem. He understands the different assumptions used for showing the hardness of a problem like $FPT \neq W[1]$, ETH, and SETH.	[1] chapters 13-15

Bibliografía General

[1] “Parameterized Algorithms”, Cygan, M., Fomin, F.V., Kowalik, Ł., Lokshtanov, D., Marx, D., Pilipczuk, M., Pilipczuk, M., Saurabh, S., 2015

Vigencia desde:	Otoño 2019
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