Master in Computer Science

Master's Information Day - 6 April 2016

Universiteit Leiden

Bij ons leer je de wereld kennen

Who is who

- Director of Education
  Prof.Dr. Thomas Bäck

- Study Advisor
- Program Director Master CS
  Dr. Marcello Bonsangue
  m.m.bonsangue@liacs.leidenuniv.nl

- Study Coordinator
  Riet Derogee
  m.derogee@liacs.leidenuniv.nl

Welcome

LIACS

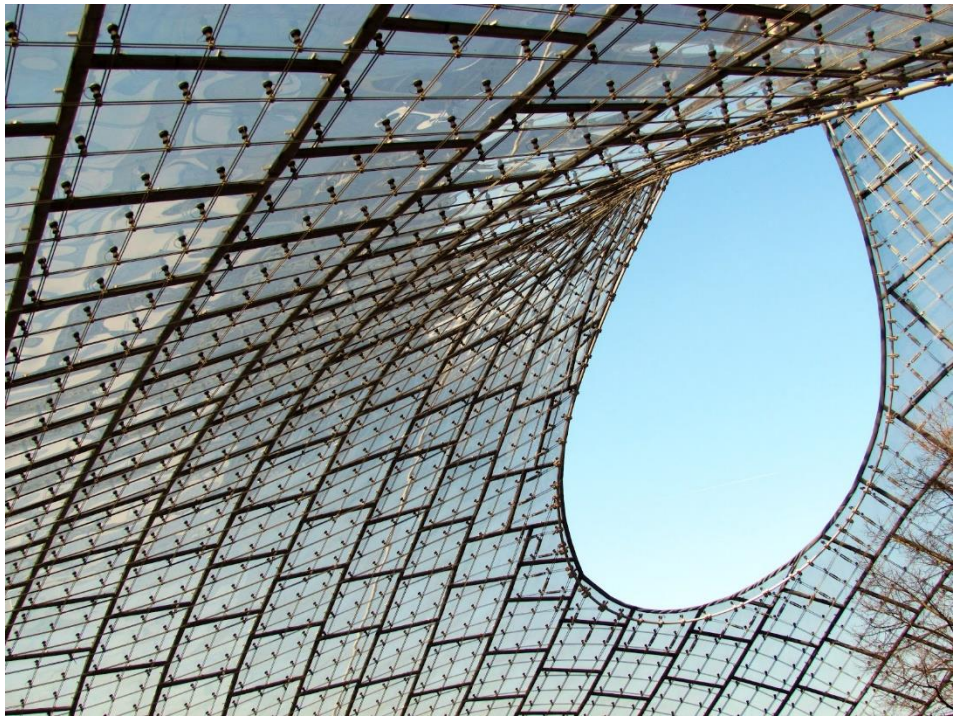
Leiden Institute of Advanced Computer Science

LIACS = the computer science institute of Leiden University

Snellius building

Willebrord Snel van Royen (1580 - 1626) was a professor of mathematics at the University of Leiden

The future (2021 - …)



STRUCTURE OF THE MASTER

Some basics

- Completely in English, of course ☺
- Two years, full-time
- Total of 120 EC (1 EC = 28 hours)
- Master of Science in Computer Science
- Info on tuition fee: Plexus (071-527 8011) or visit our website

http://en.mastersinleiden.nl/arrange/collegegeld

Admission

Admission based on

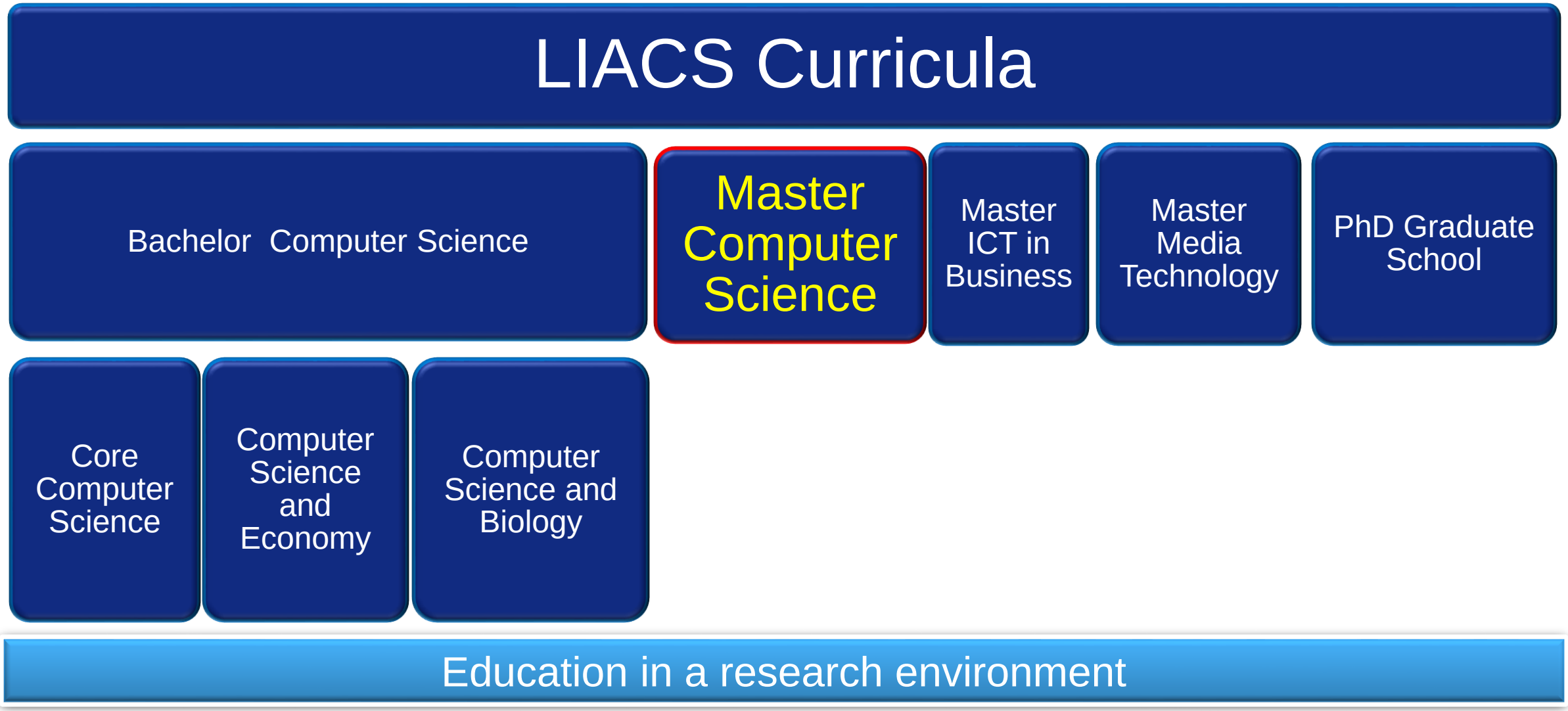
- BSc Computer Science
- HBO Computer Science (meeting with Study Advisor)

All other cases individually checked

Admission procedure:

- BSc CS degree, UL: via studielink
- Dutch BSc degree university/HBO: online application
- Foreign degree: through admissions office of university

LIACS education



LIACS education

Master Computer Science

- Computer Science and Advanced Data Analytics
- Bioinformatics
- Computer Science and Science based business
- Computer Science and Science Communication & Society

Education in a research environment

Future oriented computing techniques

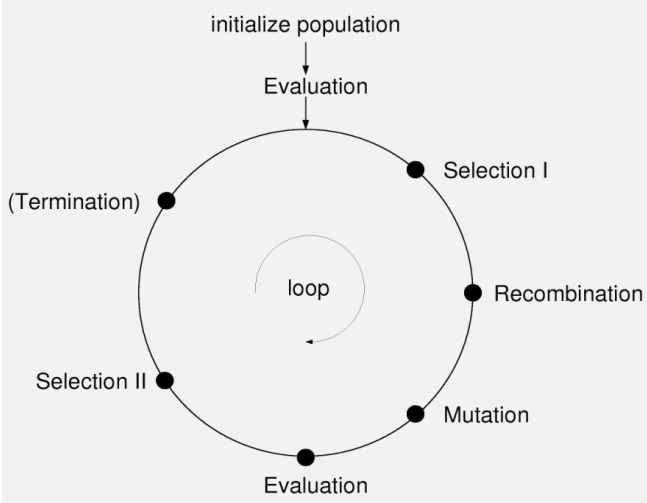
Computer Science and Advanced Data Analytics

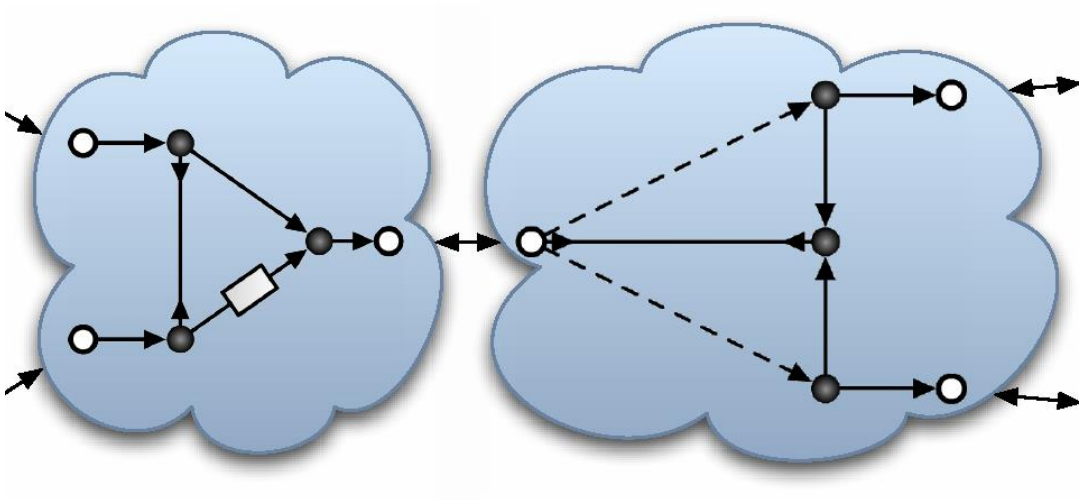
Knowledge discovery

Computer Science

Cutting edge areas of computing

- computations inspired by nature
- high performance computations
- image analysis and retrieval
- software circuits for coordination



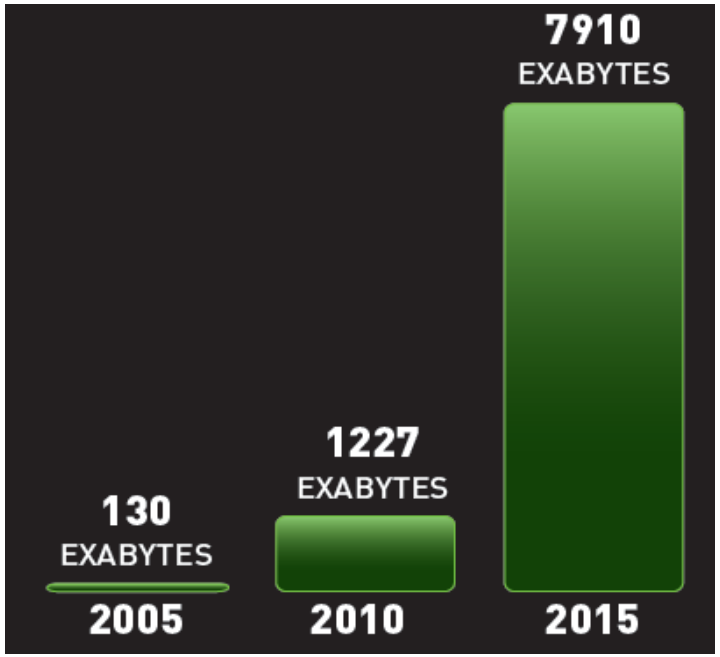


and solid foundations

- algorithms
- embedded systems
- formal methods
- software engineering

Advanced Data Analytics

"We are drowning in data, but starving for knowledge!"



Data produced worldwide
(1 exabyte = 1000^6 bytes)

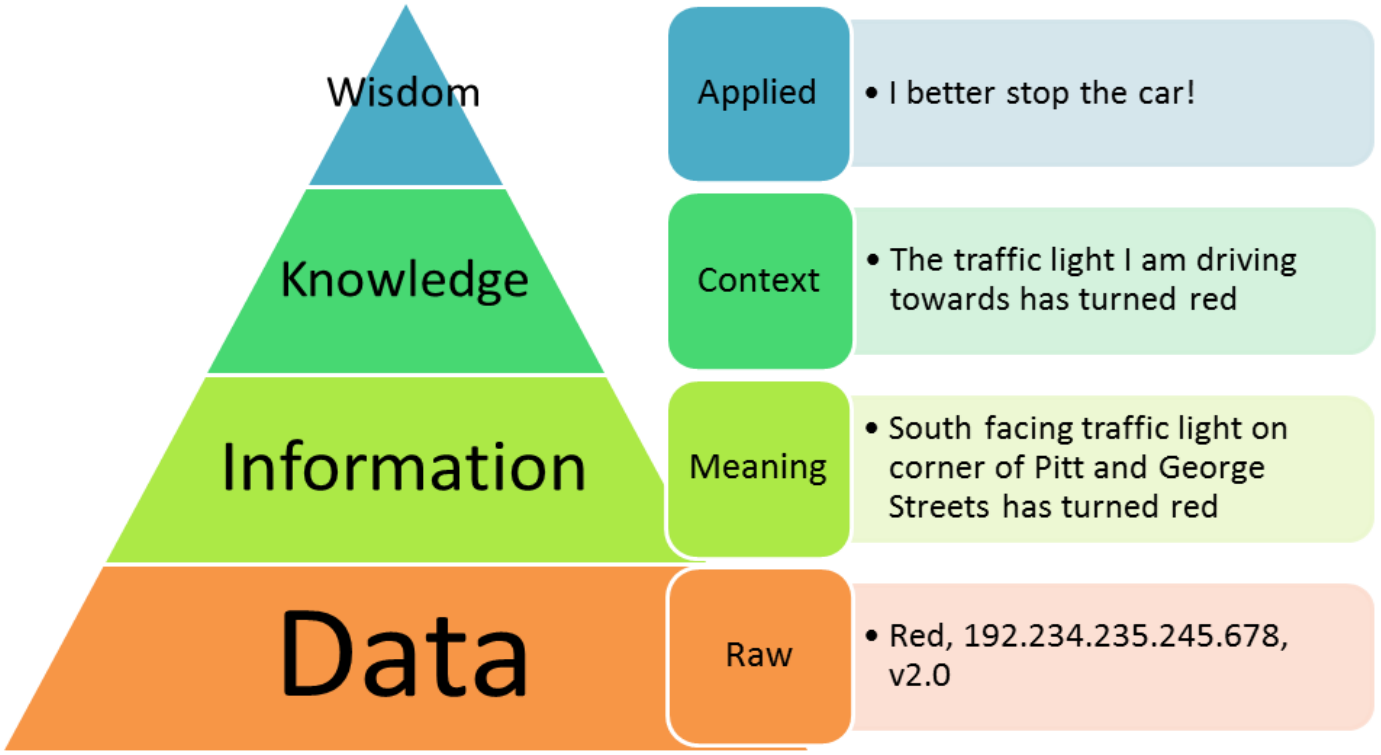
In 2020 the amount of data produced worldwide is projected to be 35000 exabytes

Examples:
- A gram of DNA can hold 455 exabytes.
- Google has ca. 10 exabytes on disk
- The sum of human-produced information (including all audio, video and text) until 1999 was about 12 exabytes of data

Advanced Data Analytics

- Data != Information != Knowledge
- Knowledge Discovery in data is the non-trivial process of identifying
  - valid,
  - novel,
  - potentially useful
  - and understandable

  patterns in data.



Education in a research environment

Algorithms and Software Technology (AST)

- Machine learning
- Data Mining
- Natural Computing
- Optimization
- Algorithms
- Theory of Software

Computer Systems and Imaging (CSI)

- Bioinformatics
- High Performance Computing
- Embedded Systems
- Imaging and multimedia
- Media technology

Computer Science and Advanced Data Analytics
-- Programme Structure --

Start 1 September or 1 February

First year

10 x courses (60 EC)

Second year

Research Project (18EC)

Master Thesis (42 EC)

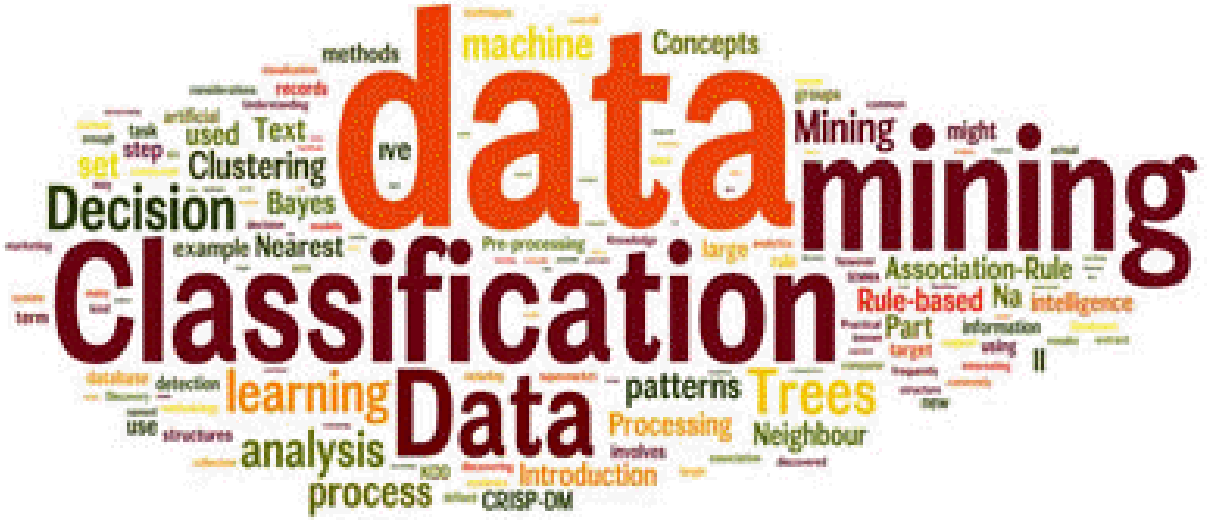
Courses 2015-2016

Individual choice of 10 specializations courses (6 EC)

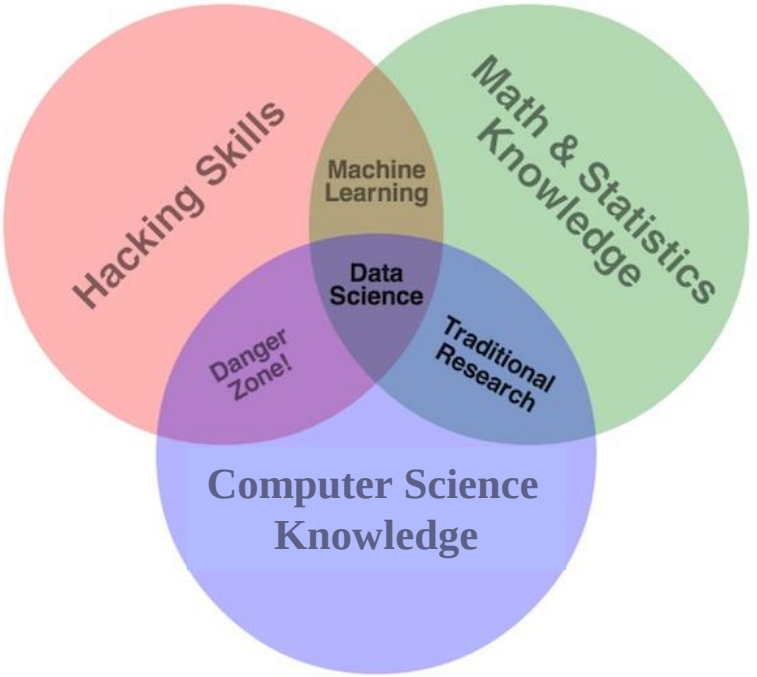
Advanced Data Analytics

Databases and Data Mining
Social Network Analysis for Computer Scientist
Multicriteria Optimization and Decision Analysis
Multimedia Information Retrieval
Seminar Distributed Data Mining
Seminar on Constraint Data Mining

Advance in Data Mining
Evolutionary algorithms
Complex Networks
Bayesian Networks
Neural Networks



New option: Data Science



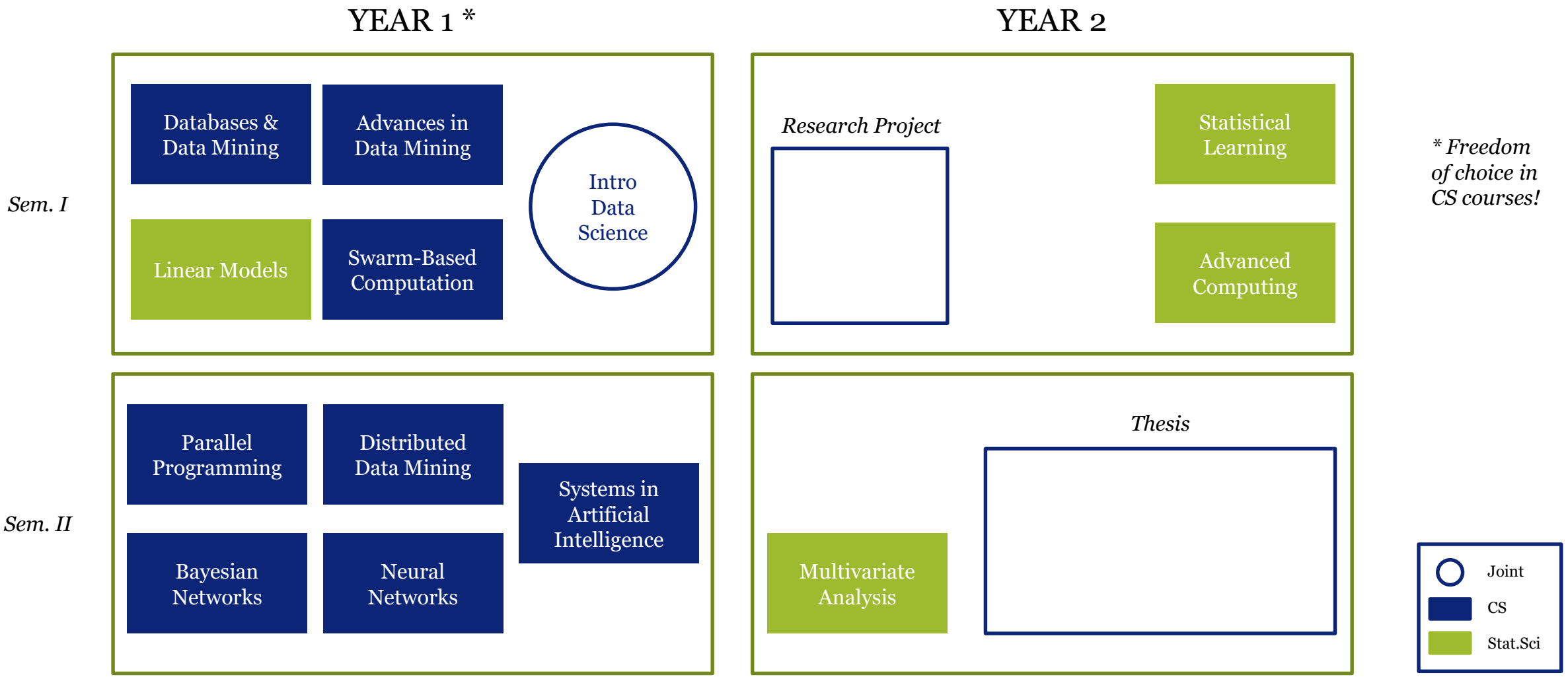
1. Data science is multidisciplinary aspects
2. Interpretation of data analysis results is crucial
3. New options in Master Programs:
   unique cooperation between top institutes of Leiden University

Mathematisch Instituut
Universiteit Leiden

LIACS
Leiden Institute of Advanced Computer Science

LCDS
LEIDEN CENTRE OF DATA SCIENCE

Data Science Option in Computer Science



Courses 2015-2016

Algorithms and Software Technology

Testing Object Oriented Systems
Swarm based Computation
Evolutionary algorithms
Databases and Data Mining
Seminar Combinatorial Algorithms
Muticriteria Optimization and Decision Analysis
System Development and Project Management

Complex Networks
Neural Networks
Coordination and Component Composition
Bio-Modelling and Petri Nets
Parallel Programming

Courses 2015-2016

Computer Systems, Imagery and Media

Multimedia Information Retrival
Embedded Systems and Software
System Development and Project Management
Testing Object Oriented Systems
Microscopy, Modeling and Visualization
Coordination and Component Composition

Audio Processing and Indexing
Complex Networks
Multimedia systems
Parallel Programming

... and many more outside LIACS

Social Network Analysis for CS

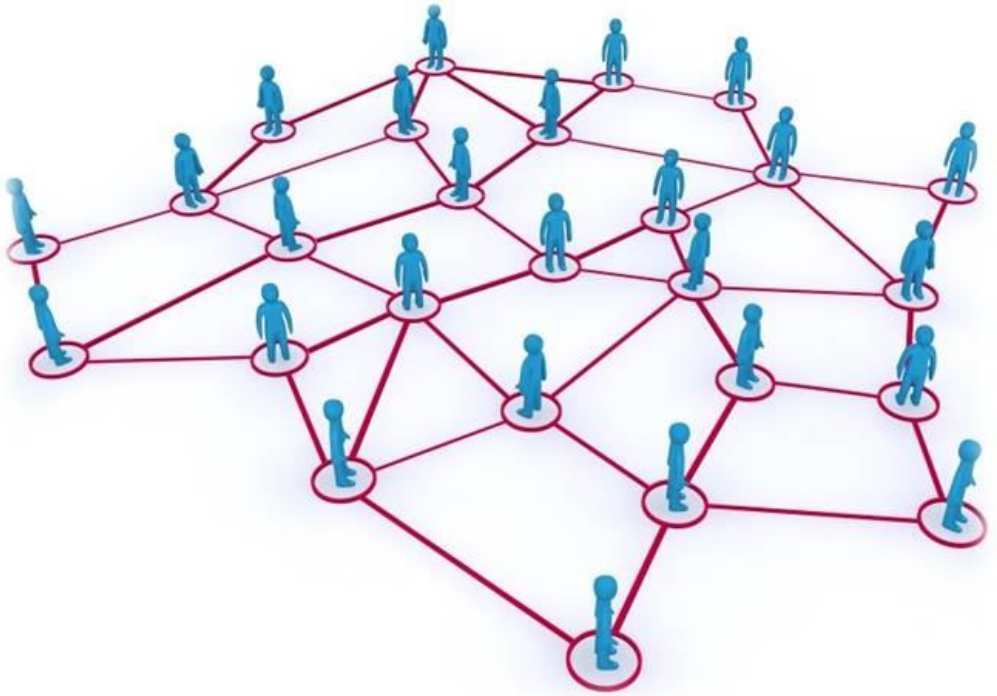
Algorithms + Graph (theory) + Data Mining

Large datasets

online social networks with millions of users and hundreds of millions of friendships

Topics

graph evolution
Twitter
community detection
Bitcoin networks
graph compression
recommendations
economic networks
Webgraphs
PageRank
link prediction



Testing Object Oriented Systems

TimSort, Android's, Java's and
Python's sorting algorithm, is broken !!

How Fast Can We Sort?

- Selection Sort, Bubble Sort, Insertion Sort, Cocktail sort, Cycle sort: $O(n^2)$
- Smooth sort, Odd-even sort, Timsort: $O(n)$
- Heap Sort, Merge sort: $O(n \log n)$
- Quicksort:
  - Average: $O(n \log n)$
  - Best: $O(n \log n)$ (simple partition) or $O(n)$ (three-way partition and equal keys)

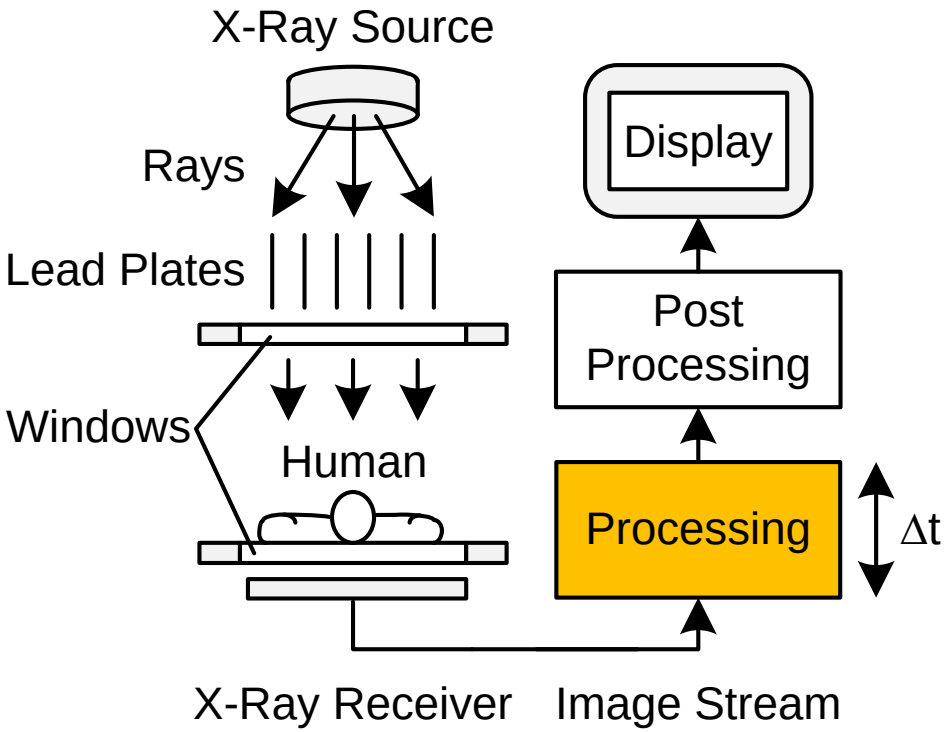
8

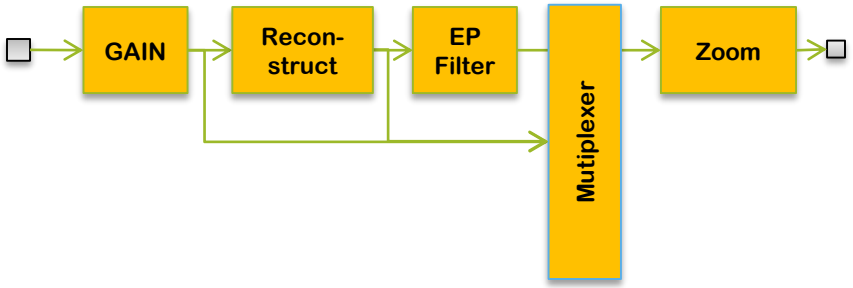
To reproduce the bug:

git clone https://github.com/abstools/java-timsort-bug.git

Language	Min. array length req. to trigger error
Android	65.536 (2^{16})
Java	67.108.864 (2^{26})
Python	562.949.953.421.312 (2^{49})

Embedded Systems and Software





- X-Ray sent through human body in heart operation
- X-Ray needs to be pre-processed to get good quality image
- Processing needs to take place in $\Delta t < 30msec$ (FDA requirement)
- Automatic translation from C code to hardware FPGA

Our context:

- *Bioscience* and *Fundamental of science* profiles of the Faculty of Science
- LUMC and Bio Science Park
- Leiden Center of Data Science
- CWI Amsterdam
- Many universities abroad
  - Europe
  - China (including key labs in Bejing, Xi'an, and Shanghai)
  - USA

Leiden Center of Data Science

Finding, analyzing and validating complex patterns in data


efpia
European Federation of Pharmaceutical Industries and Associations

idrux
PHARMINFORMATICS



TNO

BMW

NKI-AVL

LUMC

ProRail

Strukton

NWO

SITEOPS® CAD with a Brain™

Trigion

TOMTOM

HONDA

logica
be brilliant together

NXP

stw

imi
Innovative Medicines Initiative


BiG Grid
the dutch e-science grid

e-BioGrid

VolkerWessels

Masterclass

- In the second year, once every two weeks
- For all students working on research project/master thesis
- Support, exchange, stimulation, presentations, useful information
- At least two presentations per student

This is why you do it!

Recent Master Theses (2014-2015)

- Blom, Koen van der: Insect Division of Labour Applied to Online Scheduling
- Cheng, Xiwen: Application of Text Mining on Spatial Visual Sentences
- Es, Eli K. van: An Improved Maximum-Likelihood Solver for the Analysis of Graph Ensembles
- Harenslak, Bas: Content-based tag recommendation algorithms for unstructured data
- Hoogenboom, Jerry: Characterisation and Filtering of Systemic Noise in NGS Data with Applications in Forensics
- Leuven, Joost T.: Introducing User-Derived Information in the Optimization of Highly Constrained Truck Loading
- Liem, Michael: Characterizing mapk signaling in different cancers Through large public datasets
- Liu, Wei: An Evaluation Method for Nodes in Multiple Dynamic Networks
- Mirtar, Mahyaa: Mining population Movement Patterns from Cellphone Data During Natural Disasters
- Mus, Derk A.: Autonomous Simulated Car Racing through Apprenticeship Learning
- Nes, Matthijs van de: Developing Efficient Concurrent C Application Programs Using Reo
- Neuteboom, Jonathan: Protein structure prediction by Iterative fragmen T Asssembly (PITA)
- Pilios, Emmanouil: Contracting practices in traditional and agile software development
- Smeden, Frank van: A Framework for Scheduling and Analysis of Real-Time Applications without the use of Worst-Case Execution Times
- Winter, Michael de: A Missing Value Ignoring Approach for Whole Time Series Clustering of Longevity Corebody Temperature Data
- Xia, Zhihan.: A Metadata Validation Process Design for an Automated High-Throughput Screening Workflow - Case Study in Metadata of CytomicsDB

Our characteristics

- Small scale, easy interactions students-staff
  - Growth in itself is not a target for us.
  - Quality of education and the academic level of the students at the end of their study is what matters.
- Broad offer of courses + Freedom in choosing your courses
- International environment + easy to study abroad
- Choose your favorite project area by yourself
  - Data analitcs, Data Science,
  - Algorithms and software technology
  - Computer systems, imaging and media

Few figures (2015)

Ca. 100% staff members have basic qualification for education (BKO)

24 new student Master CS + 7 track Bioinformatics

40% of the students is from abroad

Percentage of students graduated in three years = 50%

Average final grade between 7.2 and 8.7

YOUR CAREER

A few examples

Zhihan Xia
Software Engineer, Pegasystems

Robin van den Broek
Software Engineer, JEM-id BV

Alexej Tessaro
Software Engineer, Expend

Alberto Baggio
Co-founder Listupp

Jan van Rijn
PhD candidate at LIACS

Jan van Rijn
Product Developer, UL

Ralph Bos
Sales manager, Landscape

Roxanna Popa
Data analyst, Euro Testing Software

Our statistics

TODAY: 96.9% of all LIACS graduates have a full-time job, and they find a job within an average time of 1.3 months.

AND IN THE FUTURE: Computer Science is a field with employment outlook ranging from average to much faster than average over the next several years.

- ✓ 9 of top 50 fastest growing careers in US for 2010-2020 are CS related [U.S. Department of Labor]
- ✓ 4 of the top 10 best and highest pay jobs in US of 2012 are CS related [U.S. News And World Report]

WHAT STUDENTS SAY

NSE Evaluations

DE MASTERS: OVERZICHT EN OORDELEN

HBO/WO COMPUTER SCIENCE

		FEITEN			STUDENTENOORDELEN							EXPERTOORDEEL			SCORE	
		Instroom	Opleidingsvorm	Voertaal	Inhoud	Docenten	Contacturen	Wetenschappelijke vorming	Praktijkgerichtheid	Communicatie	Faciliteiten	Ambitie	Programma	Toetsing en eindniveau	TOTAALSCORE	OORDEEL
Computer Science algemeen (2-jarig)																
Eindhoven TU/e	Computer Science and Engineering	74	vt	En	+	+	+	0	+	+	0	0	0	+	72	+
Open Universiteit	Computer Science	10	afst	Ne	+	++	nb	+	0	+	+	0	0	0	72	
Leiden UL	Computer Science	31	vt	Ne,En	+	+	0	+	0	+	0	0	0	0	68	+
Nijmegen RU	Computing Science	90	vt	Ne,En	0	0	+	0	+	+	+	0	0	0	66	+
Delft TUD	Computer Science	97	vt	En	0	0	+	0	0	0	0	0	+	+	66	+
Enschede UT	Computer Science	42	vt	En	0	+	0	0	0	+	+	0	0	0	66	+
Utrecht UU	Informatica	85	vt	En	0	0	-	0	0	0	0	0	0	0	58	0
Groningen RUG	Computing Science	22	vt	En	0	0	+	-	0	0	- -	0	0	0	56	0
Delft TUD	Computer Engineering	20	vt	En	-	-	0	-	0	0	0	0	0	0	54	-
Amsterdam VU	Computer Science	37	vt	En	-	0	0	-	-	-	0	0	0	0	52	-

Strengths (Student‘s view)

- Research at LIACS
- Choices, flexibility (courses, software project)
- Small groups, easy interaction with researchers
- Easy to find supervisor
- Good course schedule
- Company opportunities

AND FINALLY …

Asking for help

Every staff member (professors and others)
- has gone through a master study before
- is willing to giving advice
- is expected to give advice
- is generally good at giving advice

At LIACS this means
- 25+ experts to advise you
- plus all other students who may also have useful insights

Still have Questions?
Talk to our staff, student or alumni

Or send an e-mail to:
m.m.bonsangue@liacs.leidenuniv.nl

Science.leidenuniv.nl
Leidenscience-200.nl

LeidenScience

@LeidenScience
#LeidenScience200

Faculty of Science
Universiteit Leiden

User: FWNBCM

Leidenscience

Universiteit Leiden

Bij ons leer je de wereld kennen