Data Science
Master’s programs
Who are we?

Willem-Jan van den Heuvel
Tilburg University

Ksenia Podoynitsyna
Eindhoven University of Technology
Program

- What is Data Science?
- The Data Science Initiative
- About the programs
- Labor market

Start as of September 2016
(On the condition of accreditation)
The production of data is staggering

- People produce 400 million tweets daily
- ... and send 3.2 billion likes daily
- They also upload 300 million pictures daily
- Google Voice processes 10 years of spoken text daily
- The UK has 2 million surveillance cameras
- Facebook has 1 billion users
- 800 million users watch 4 billion movies daily
- Medical data doubles every five years
- In 2020 there will be 24 billion internet connected devices

Source: NRC 08.02.2013; Gartner 2014
The Always-On Society connects

Connected devices

Sensing and monitoring data

Providing connected Apps

Extracting meaningful information

Enhancing the user experience

Connected Solutions
Low storage cost

Hard Drive Cost per Gigabyte 1980 - 2009

Tilburg University

Technische Universität Eindhoven
University of Technology
Data will open new productivity venues

**Body monitoring**
Monitors non-intrusively biomarkers and body functions and feeds information.

**Smart maintenance**
Monitors performance remotely and enables long-distance control and maintenance.

**Customer mapping**
Analyzes customer behavior and maps needs on potential business propositions.

**Body monitoring**
Monitors non-intrusively biomarkers and body functions and feeds information.

**Smart maintenance**
Monitors performance remotely and enables long-distance control and maintenance.

**Customer mapping**
Analyzes customer behavior and maps needs on potential business propositions.

**Data security & privacy**
Investigates security and privacy issues related to the trade and use of data in a global setting.

**City management**
Enables adaptive outdoor lighting and supports urban service management and commissioning.

**Home control**
Monitors the habitation of buildings and/or homes and provides feedback on the use of resources.
Big data will change science itself

**CHANGE: SCIENCES**

Data scientists explore more ways to deal with big data's volume, velocity, and variability, they are starting to develop new approaches to analyzing information.

- **Volume**: (1TB per sample) to account for human variability
- **Velocity**: scalability and new high speed databases
- **Variability**: combining thousands of different datasets

Source: Science 2014 (DOI: 10.1126/science.opms.p1400086)

**CHANGE: CROWD CONTROL**

[Image of a crowded place]
Data Science: Definition

The science that develops methods and techniques to turn data into value

Algorithms

Statistics

Business Analytics

Social Context
TiU-TU/e Data Science Initiative

Grand Initiative in Data Science (GRIDS)
- Strong international reputation of TU/e (engineering) and TiU (social and business sciences)
- Develop an internationally reputed Graduate School in Data Science

Educational offerings:
- Combined Bachelor’s program – TU/e and TiU
- Joint MSc Data Science & Entrepreneurship
- Master’s track Data Science: Business and Governance (TiU) - Focus on Business
- Master’s track Business Analytics and Operations Research (TiU) - Focus on Process Optimization
- Special master’s program Data Science in Engineering (TU/e) - Focus on Engineering
TiU-TU/e Data Science Initiative

Integrated Offering

A mix of partners

- Large corporates
- Government organizations
- Web based & data corporations
- Large consultancies & specialized data consultancies
- Data providers
- Data communities
- Specialized SME’s (data/web)
TiU-TU/e Data Science Initiative

Tilburg University

Data Science Bachelor

Data Science Master Business and Society

Mariënburg Den Bosch

Data Science Master Entrepreneurship

Eindhoven University of Technology

Data Science Master Engineering
MSc Data Science and Entrepreneurship

• Learn to exploit the data revolution
• Develop innovative, value-adding and sustainable business activities
  (Within existing corporations and new start-ups)
• Learn to translate innovative data-centered ideas into technological solutions/ventures
Outline of the program

- Two years' program in ‘s-Hertogenbosch
- Interdisciplinary perspective
- Teams of lecturers from both universities
- Blended learning (combining off-line and online teaching methods)
- Every course uses a data set
## The curriculum

<table>
<thead>
<tr>
<th></th>
<th>YEAR 1</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semester 1</strong></td>
<td>Data Entrepreneurship in Action I - Fundamentals</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Data Mining</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Intellectual Property and Privacy</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Data Integration and Architecture</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Strategy and Business Models</td>
<td>6</td>
</tr>
<tr>
<td><strong>Semester 2</strong></td>
<td>Data Entrepreneurship in Action II</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Business Analytics</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2 Electives</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Creative Thinking and Open Innovation</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>60</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>YEAR 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semester 1</strong></td>
<td>Data Entrepreneurship in Action III</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Data-Driven Business Process Management</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Law, Ethics and Entrepreneurship</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2 Electives</td>
<td>12</td>
</tr>
<tr>
<td><strong>Semester 2</strong></td>
<td>Master’s Thesis Project</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>60</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>120</strong></td>
</tr>
</tbody>
</table>
Some examples of courses

<table>
<thead>
<tr>
<th><strong>Data Mining</strong>: useful (actionable) insights from the data with help of some computational tools:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Companies improve their market share</td>
</tr>
<tr>
<td>• Environmentalists recognize whales in the open ocean</td>
</tr>
<tr>
<td>• Psychologists to gain insight in the brain</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Strategy and Business Models</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• How to differentiate from competition</td>
</tr>
<tr>
<td>• How to manage the business ecosystem and/or related platform</td>
</tr>
<tr>
<td>• When and how to apply business model innovation</td>
</tr>
<tr>
<td>• Help companies in a data-driven business</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Data Integration and Architecture</strong>: combine data management and data integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>• create an understanding of conceptual database models</td>
</tr>
<tr>
<td>• design data structures that will limit redundancy and enforce data integrity</td>
</tr>
<tr>
<td>• combine data from several heterogeneous disparate sources</td>
</tr>
<tr>
<td>• increase the completeness, conciseness, and correctness of data</td>
</tr>
</tbody>
</table>
Satellite data example

NSO portal for publicly available, free satellite data:
- Imaging, temperatures, wind speeds, humidity, photo’s, etc.
- Bridge sinking, ground humidity measurements for farmers, (illegal) cannabis in the attic, berth use in the haven, check for meadows covered by water for subsidies, …
Data Entrepreneurship in Action I, II and III

- A series of three projects that bind together certain elements of other courses in the semester
- originating from the data set opportunities provided by an external company
- within one of the five domains: (1) marketing and branding; (2) smart industries; (3) health; (4) agro and food; (5) legal analytics
- interact with all relevant ecosystem stakeholders with a potential interest
Unique features

• Joint collaboration of TU/e and TiU. Students receive a joint diploma that is issued by both universities.
• The beautiful Mariënburg Monastery.
• Students are registered at both universities.
• Courses are taught by lecturers from both universities in ‘s-Hertogenbosch.
Admission

Possible BSc programs:
• Data Science

Indicative:
• Software Science/Web Science
• Information Management
• Business Informatics
• Industrial Engineering
• Applied Mathematics
• Econometrics
Data Science: Business and Governance @TiU

- Data Exploration and Preparation
- Data Representation and Transformation
- Computing with Data
- Data Modeling
- Data Visualization and Presentation
- Science about Data Science
- Economic and Legal Aspects of Data Science
# The Full Scope of the DSBG program

## Master Data Science: Business & Governance 2015-2016

<table>
<thead>
<tr>
<th>Semester</th>
<th>Block</th>
<th>Course Title (RS = Research Skill)</th>
<th>ECTS</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
<td>Data Science Regulation &amp; Law (TLS)</td>
<td>6</td>
<td>620087</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elective course A, B or C (TSH, TISEM or TSB)</td>
<td>6</td>
<td>620089</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Governance and Policy Making</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Business Intelligence and Data Management</td>
<td>32</td>
<td>0092</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Causal Analysis in Data Science</td>
<td>42</td>
<td>4301</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RS Data Processing</td>
<td>3</td>
<td>880254</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
<td>Social Data Mining</td>
<td>6</td>
<td>880222</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elective course D, E or F (TLS, TISEM or TSB)</td>
<td>6</td>
<td>620088</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Data Science: Sustainability, Privacy &amp; Security</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Business Process Integration</td>
<td>32</td>
<td>0062</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Psychological and Sociological Measurement in Data Science</td>
<td>42</td>
<td>4300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RS Statistical Programming with R</td>
<td>3</td>
<td>880256</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Master thesis / Data Science in Action</td>
<td>1</td>
<td>880502</td>
</tr>
<tr>
<td>2.</td>
<td>3.</td>
<td>Analytics for Business and Governance (TISEM)</td>
<td>6</td>
<td>320098</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RS Web Analytics</td>
<td>3</td>
<td>880493</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RS Machine Learning</td>
<td>3</td>
<td>880501</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Master Thesis / Data Science in Action</td>
<td>2</td>
<td>880502</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Master Thesis / Data Science in Action</td>
<td>15</td>
<td>880502</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>
Business Analytics and Operations Research

Business analytics:
• Extracting valuable information from data to solve business problems.

The program Business Analytics and Operations Research focuses on quantitative methods and techniques in:
• **Data Science:**
  • To extract valuable information from (big) data sets.
• **Operations Research:**
  • To solve complex decision problems (for businesses, governments,....).
Business Analytics and Operations Research

• The combination of Data Science and Operations Research techniques allows you to solve complex decision problems in a wide variety of fields:
  • Logistics (vehicle routing, supply chain optimization, inventory management)
  • Medical field (donor kidney allocation, optimizing tumor treatment plans)
  • Public sector (dike height optimization, train scheduling)
  • …

• The emphasis is on relevant, real-world learning:
  • You learn to solve actual business problems and to turn data into managerial insights.

• The program offers a comprehensive course on the non-quantitative professional skills that are essential to successfully apply analytics in practice.
Business Analytics and Operations Research

• **Program starts September 2016**

• **Entry requirements**
  • Strong quantitative skills
  • BSc Econometrics and Operations Research, BSc Mathematics, or equivalent in terms of quantitative skills.

• **More information:**
Data Science in Engineering @TU/e

- Multi-disciplinary program on handling data and information
- Combines topics from computer science, mathematics, and industrial engineering
- Special track
## Data Science in Engineering curriculum overview

<table>
<thead>
<tr>
<th>Mandatory courses</th>
<th>Core courses (3 out 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Portfolio (contains Data Challenge)</td>
<td>Advanced algorithms</td>
</tr>
<tr>
<td>Statistics for Big Data</td>
<td>Web information retrieval and data mining</td>
</tr>
<tr>
<td>Statistical Learning Theory</td>
<td>Visualization</td>
</tr>
<tr>
<td>Advanced process mining</td>
<td></td>
</tr>
</tbody>
</table>

### DSE stream electives

- Statistical bioinformatics (EE)
- Business intelligence (IE&IS)
- Interactive virtual environments (CS)
- Algorithms for geographic data (CS)
- Principles of data protection (CS)
- Time series analysis and forecasting (IAM)
- Business Process Simulation (CS)
- Probability and stochastic processes I & II (IAM)

...  

- **Stream electives (15 EC)**  
- **Room for 15 EC international activity in Q5 or Q6**
A New Profession

THE PERFECT DATA SCIENTIST

OPEN MIND

CREATIVE

HUMAN INTEREST

KNOW HOW TO DO BUSINESS

ANALYTICAL

© Marion van de Wiel 2014
Labor market

We Want You
Questions?

www.tilburguniversity.edu/education/masters-programmes/
and
www.tue.nl/masterprograms