

# Data science – How to prepare engineers for this field

Ivica Marković

Department of Computer Science  
Faculty of Electronic Engineering  
University of Niš, Serbia



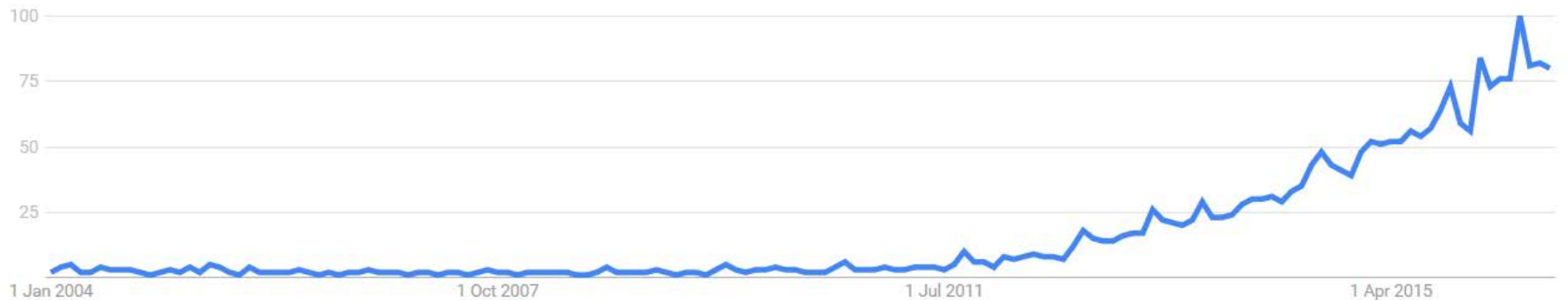
# Outline

- **Data Scientist job trends**
- Data growth and demands for analysis
- Data Science – fields and required knowledge
- Related courses at our faculty
- Conclusion

# Data Scientist Job Trends

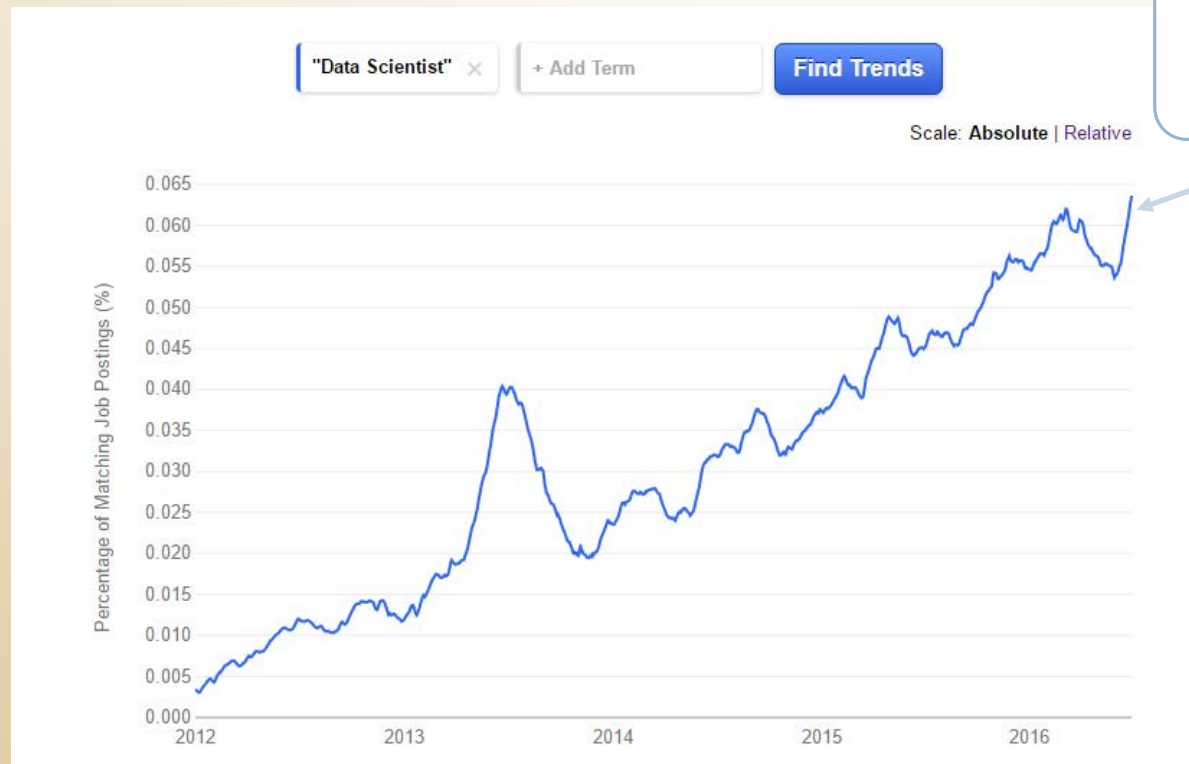
- Source: [www.google.com/trends](http://www.google.com/trends)
- Search term: "Data Scientist"

Interest over time ?



# Data Scientist Job Trends

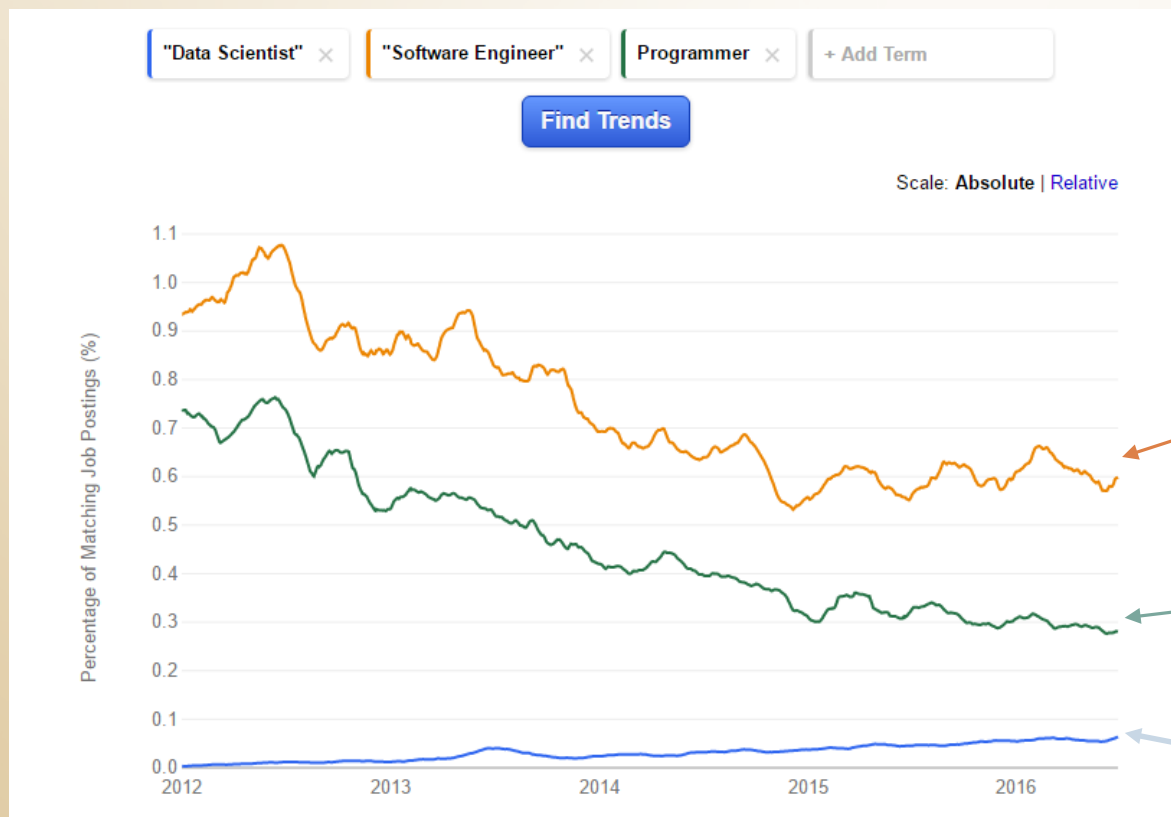
- Source: [www.indeed.com/jobtrends](http://www.indeed.com/jobtrends)



Data Scientist

# Data Scientist Job Trends

- Source: [www.indeed.com/jobtrends](http://www.indeed.com/jobtrends)



Software Engineer

Programmer

Data Scientist

# Data Scientist Job Trends

- Data Scientist became one of “most wanted” jobs
- Companies offer higher salaries to Data Scientists than for example to Software Engineers
- A study based on employees feedback lists Data Scientist as #1 job in terms of work-life balance
- There are estimates that companies will need 1 million Data Scientists by 2020
- Why are companies in such high demands for Data Scientists?

# Outline

- Data Scientist job trends
- **Data growth and demands for analysis**
- Data Science – fields and required knowledge
- Related courses at our faculty
- Conclusion

# Data Growth

- There is an estimation that humankind was able to store  $2.9 \times 10^{20}$  bytes of data (290 exabytes) and to communicate  $2 \times 10^{21}$  bytes of data (2 zettabytes) in period from 1986 to 2007
- Reference: M. Hilbert, P. López, "The World's Technological Capacity to Store, Communicate, and Compute Information", Science 01 Apr 2011: Vol. 332, Issue 6025, pp. 60-65

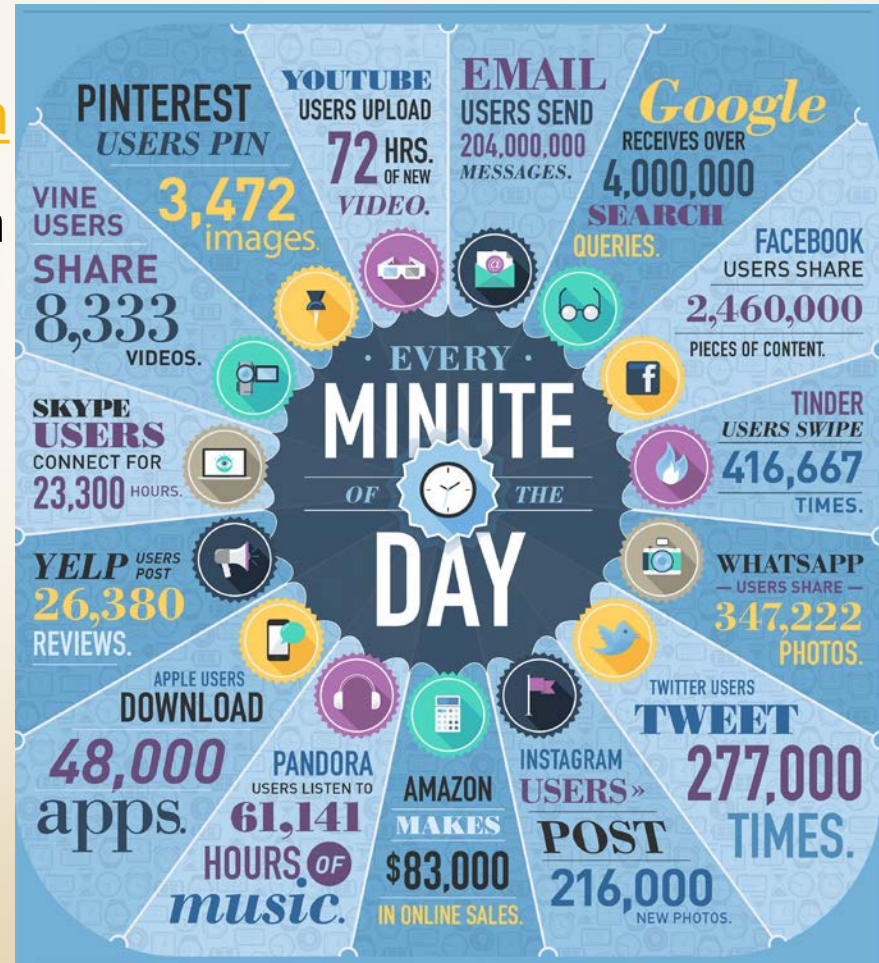


# Data Growth

- A more recent estimation by Cisco company published in June 2016
- Part of the Cisco Visual Networking Index (Cisco VNI), an ongoing initiative to track and forecast the impact of visual networking applications
- Annual global IP traffic will surpass the zettabyte ( $10^{21}$ ) threshold in 2016, and will reach 2.3 ZB by 2020
- Global IP traffic will increase nearly threefold over the next 5 years, and will have increased nearly 100-fold from 2005 to 2020
- Smartphone traffic will exceed PC traffic by 2020

# Data Growth

- Source: [www.domo.com](http://www.domo.com)
- Based on 2011-2013 data



# Some Important Areas / Data Sources

- Industry
- Finance
- Government
- Social networks
- Games
- Internet of Things
- Internet security

# Outline

- Data Scientist job trends
- Data growth and demands for analysis
- **Data Science – fields and required knowledge**
- Related courses at our faculty
- Conclusion

# Data Science – Fields and Required Knowledge

- The following skills are usually required by Data Scientist job descriptions:
  - Computer science
  - Math
  - Statistics
  - Machine learning
  - Domain expertise
  - Communication and presentation skills
  - Data visualization



# Outline

- Data Scientist job trends
- Data growth and demands for analysis
- Data Science – fields and required knowledge
- **Related courses at our faculty**
- Conclusion

# Basic Academic Studies at the FEE Niš

- 4 years
- 240 ECTS credits
- 6 modules in total
- 480 students at the 1<sup>st</sup> year (common for all modules)
- 180 students at the 2<sup>nd</sup> year at Computer Science and Informatics module





# Master Academic Studies at the FEE Niš

- 1 year
- 60 ECTS credits (240 ECTS credits required to enroll the program)
- 5 study programs
- 13 modules
- Computer Science and Informatics study program
  - Computer Engineering
  - Information Technologies
  - Software Engineering
  - Computer Systems Security
  - Information Systems

# Data Science Related Courses

| Course                         | Level  | Modul                            | Year | Semester | ECTS | Status     |
|--------------------------------|--------|----------------------------------|------|----------|------|------------|
| Artificial Intelligence        | Basic  | Computer Science and Informatics | 4    | 1        | 6    | Compulsory |
| Information Retrieval          | Basic  | Computer Science and Informatics | 4    | 1        | 6    | Optional   |
| Introduction to Data Mining    | Master | Information Technologies         | 1    | 1        | 4    | Optional   |
| Basic Techniques in Web Mining | Master | Information Technologies         | 1    | 1        | 4    | Optional   |
| Multimedia Data Analysis       | Master | Computer Systems Security        | 1    | 1        | 4    | Optional   |
| Pattern Recognition            | Master | Information Technologies         | 1    | 1        | 4    | Optional   |
| Natural Language Processing    | Master | Information Technologies         | 1    | 2        | 4    | Optional   |

# Experiences from Introduction to Data Mining Course

- Optional course
- Usually about 5 students
- We were very happy during the academic year 2014/2015 (10 students, 5 of them were really excellent in this area)
- Good cooperation with local companies

# Related Master and Bachelor Theses in 2015 and 2016 at the FEE Niš

- Detecting masquerade network attack based on Markov chain and Hidden Markov model
- Classifying text in areas of sports, politics and technology
- Anomaly detection based on clustering
- Classification of film comments by using RapidMiner tool
- Recognition of music genres

# Outline

- Data Scientist job trends
- Data growth and demands for analysis
- Data Science – fields and required knowledge
- Related courses at our faculty
- **Conclusion**

# Conclusion

- Global companies are in high demand for Data Scientists
- There are also local small companies in Niš working in this area
- The Faculty of Electronic Engineering offers several courses related to Data Science
- Future goals:
  - Offer more Data Science related courses and try to adjust mathematics courses according to requirements of Data Science related courses
  - Motivate more students to choose this area and possibly work at the faculty



# Thank you!