The Emerging Role of Data Scientists on Software Development Teams

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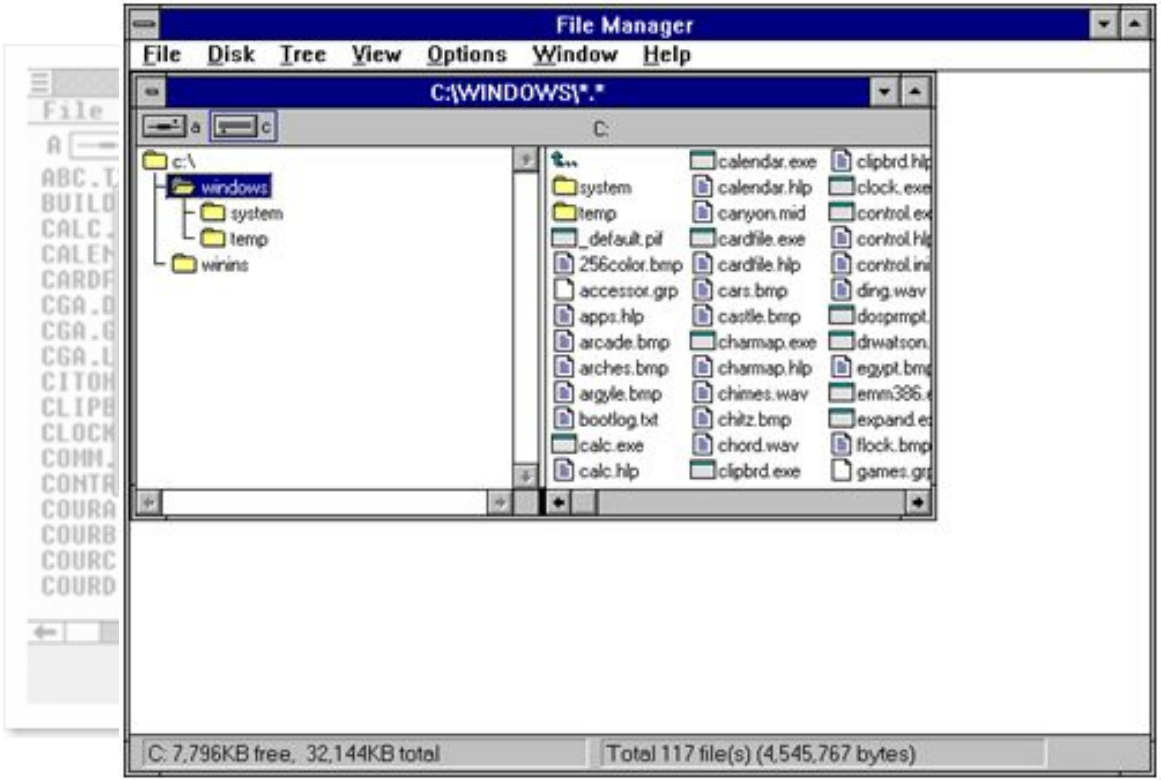
Introduction

- Software teams are increasingly using **data analysis**
  - Informing their engineering and business **decisions**
  - **Building** data solutions

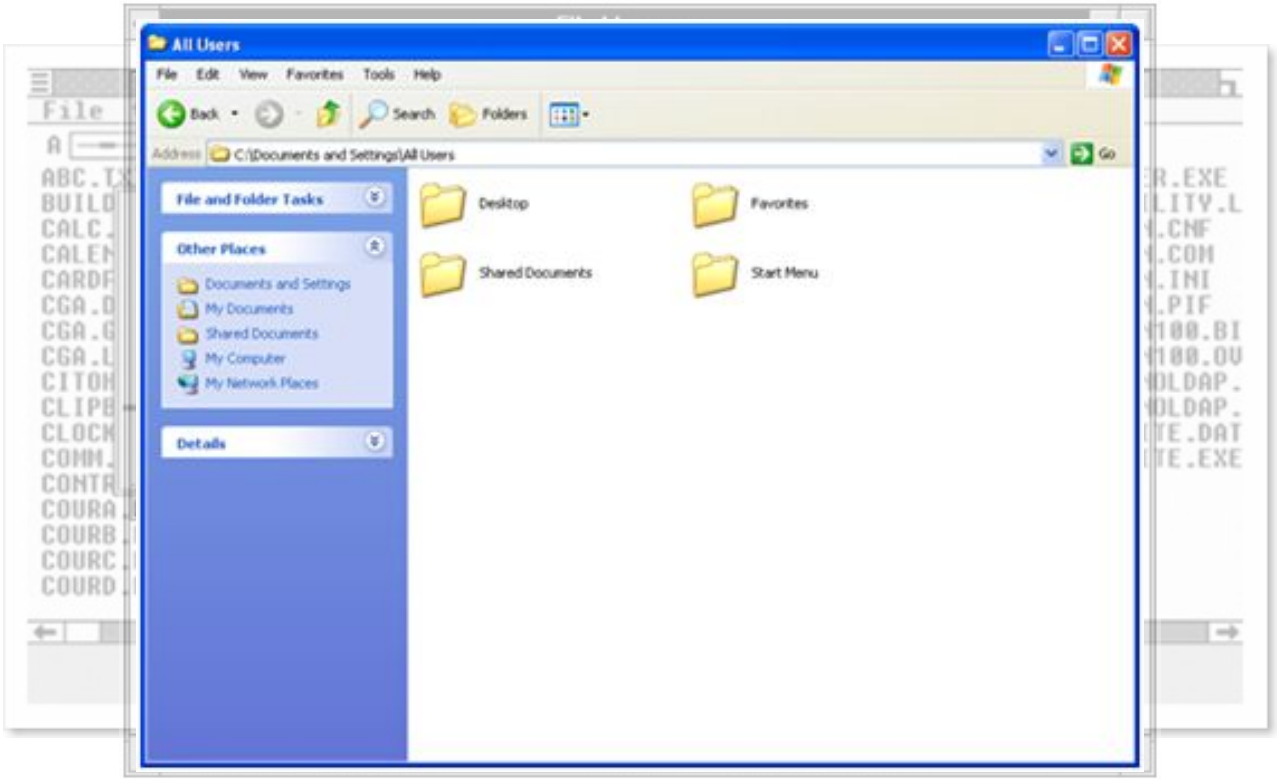
- The role of ***data scientist*** is becoming standard on development teams, alongside existing roles like **developers**, **testers**, and **program managers**

- Teams also need effective ways to **operationalize** data analytics

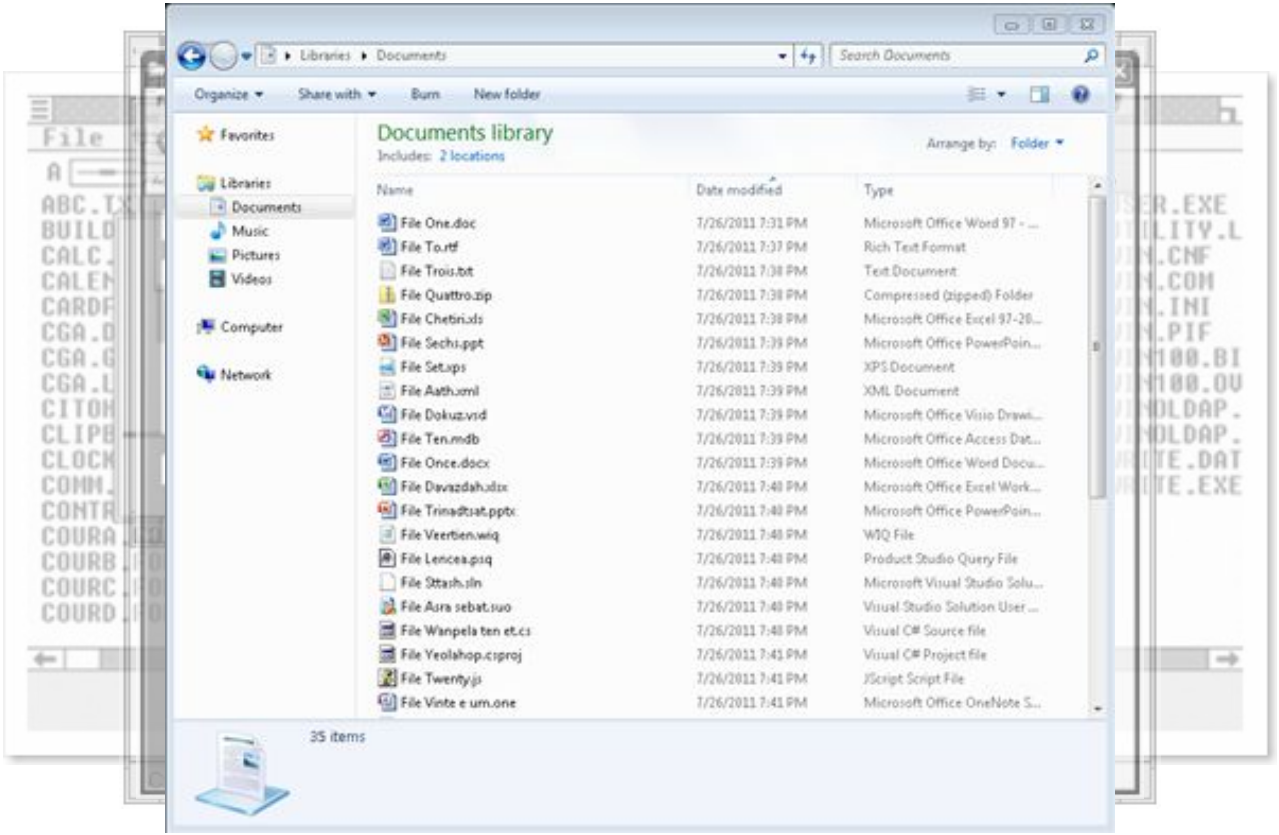
MS-DOS Executive - Windows 1.0



File Manager - Windows 3.1

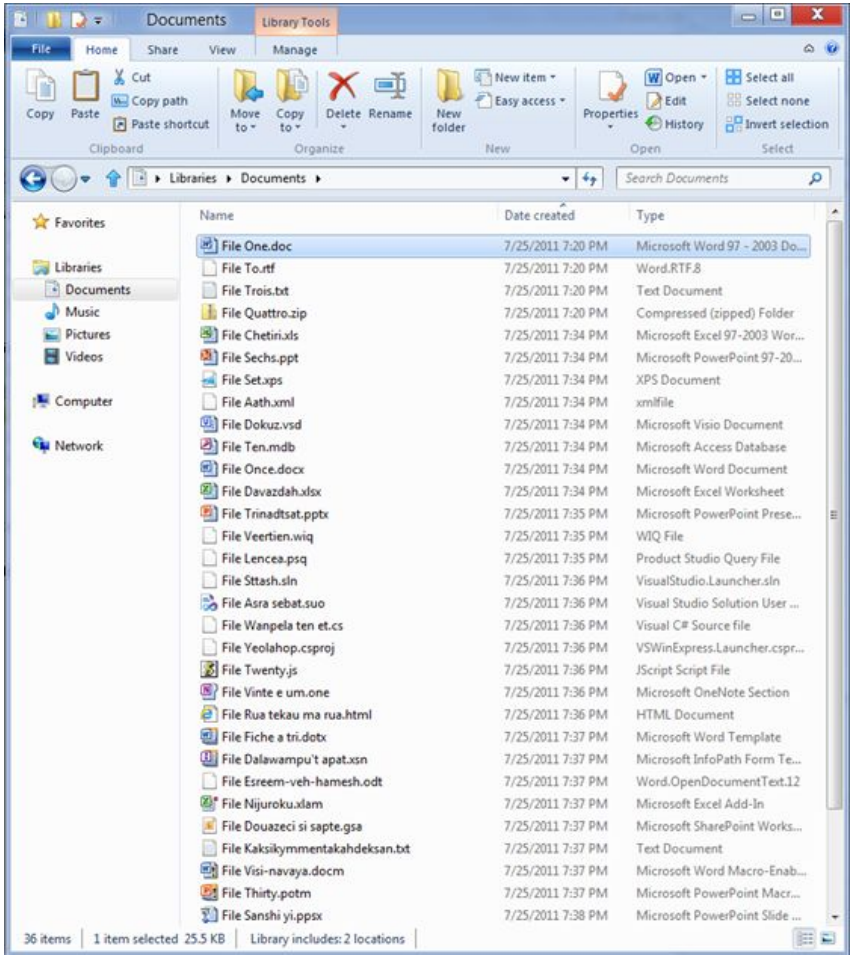


Explorer - Windows XP



Explorer - Windows 7

Top 10 commands are 81.8% of Explorer Command Use!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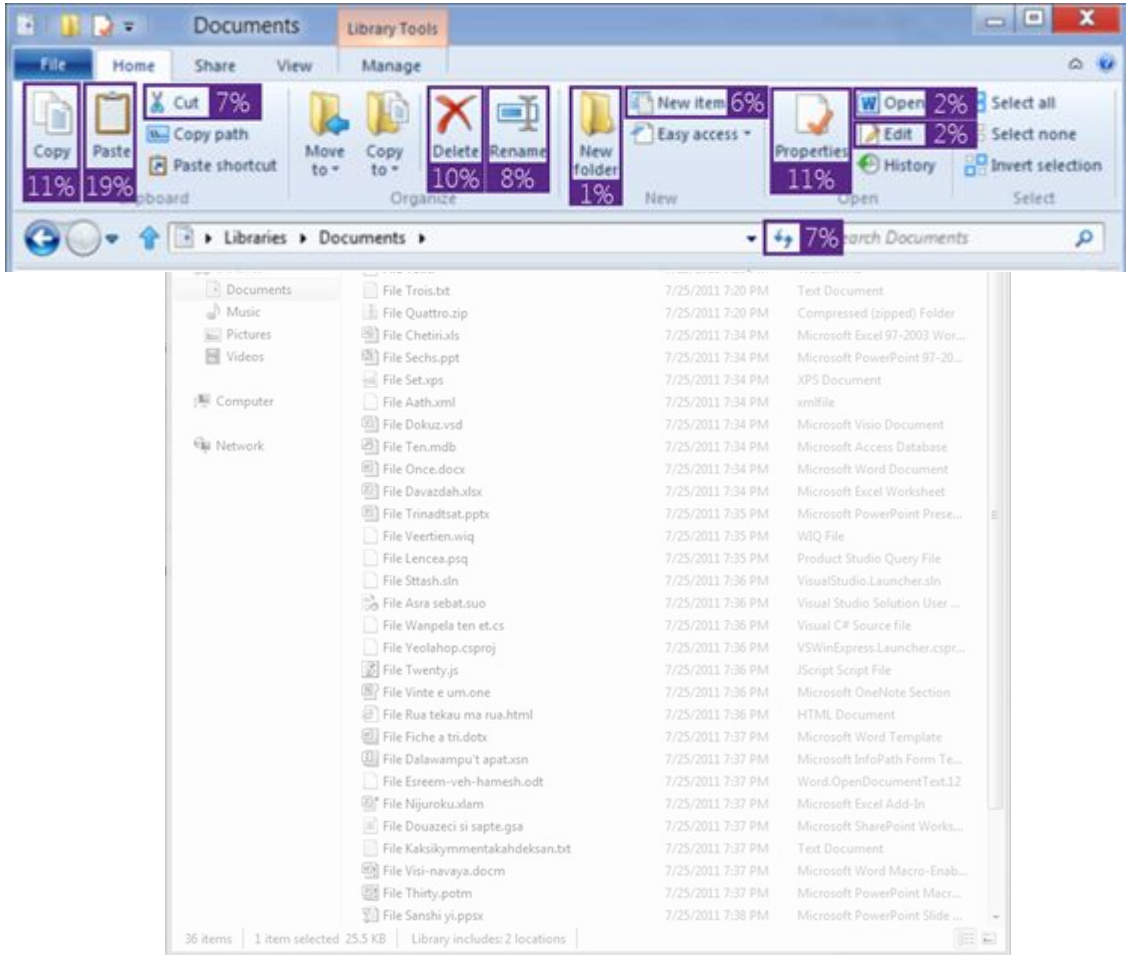
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What is the emerging role that data scientists play within software development teams?

***Q1*: Why are data scientists needed in software development teams and what competencies are important?**

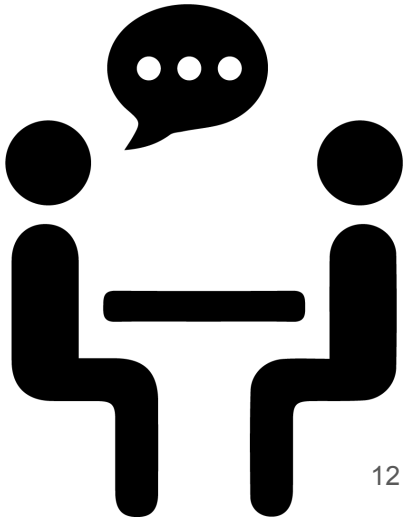
***Q2*: What are the educational and training backgrounds of data scientists in software development teams?**

***Q3*: What kinds of problems and activities do data scientists work on in software development teams?**

***Q4*: What are the working styles of data scientists in software development teams?**

Methodology (1/2)

- One-hour, semi-structured **interviews**
- Conducted by **two** authors
  - One interviews and the second takes notes
- Interviews **audio-taped** and later **transcribed** for analysis



Methodology (2/2)

- Participants selections (*snowball sampling*):
  - Identified **presenters** and **technical leaders** responsible for sharing best practices
  - Additional data scientists by **word-of-mouth**

- Data Analysis:
  - Atlas.TI **qualitative** coding tool
  - Identification of **themes** and **codes**

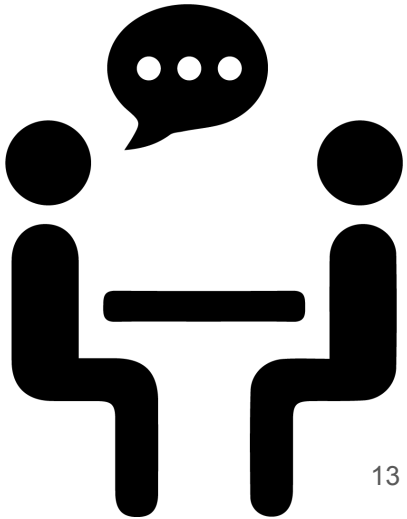


TABLE 1. PARTICIPANT INFORMATION

	Title	Education
P1	Data Scientist II	BS in CS / Statistics, MS in SE, currently pursuing PhD in Informatics
P2	Director, App Statistics Engineer	MS in Physics
P3	Principal Data Scientist	MBA, BS in Physics / CS, currently pursuing PhD in Statistics
P4	Principal Quality Manager	BS in CS
P5	Partner Data Science Architect	PhD in Applied Mathematics
P6	Principal Data Scientist	PhD in Physics
P7	Research Software Design Engineer II	MS in Computer Science, MS in Statistics
P8	Program Manager	BS in Cognitive Science
P9	Senior Program Manager	BSE in CS and BAS in Economics/Finance
P10	Director of Test	BS in CS
P11	Principal Dev Manager	MS in CS
P12	Data Scientist	PhD in CS / Machine Learning
P13	Applied Scientist	PhD in CS / Machine Learning and Database
P14	Principal Group Program Manager	BS in business
P15	Director of Data Science	PhD in CS / Machine Learning
P16	Senior Data Scientist	PhD in CS / Machine Learning

16 Participants (5 women, 11 men)

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P4	Principal Quality Manager	BS in CS
P5	Partner Data Science Architect	PhD in Applied Mathematics
P6	Principal Data Scientist	PhD in Physics
P7	Research Software Design Engineer II	MS in Computer Science, MS in Statistics
P8	Program Manager	BS in Cognitive Science
P9	Senior Program Manager	BSE in CS and BAS in Economics/Finance
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8 Different Organizations at Microsoft
Different Job Titles

Why are Data Scientists Needed in Software Development Teams?

- Demand for **Experimentation**
  - Designing experiments with real user data (tests)

- Demand for **Statistical Rigor**
  - Hypothesis testing, Confidence intervals, and Baselines through normalization

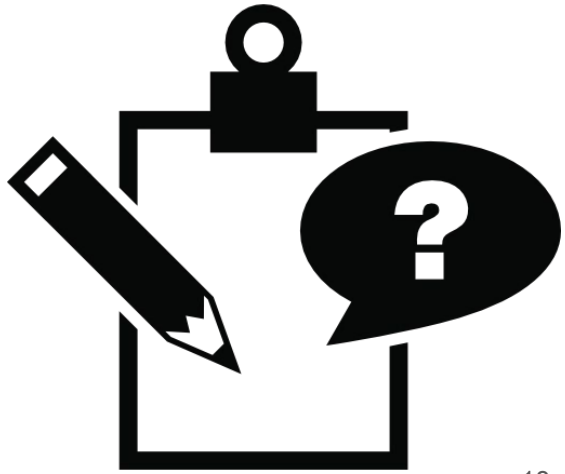
- Demand for **Data Collection** Rigor
  - Shaping and cleaning data

Background of Data Scientists

- **Higher** education degree
- Strong **passion for data**
- Capacity for identifying and refining **questions**

Problems that Data Scientists Work on

- Performance Regression
- Requirements Identification
- Fault Localization and Root Causes Analysis
- Bug Prioritization
- Server Anomaly Detection
- Failure Rate Estimation
- Customer Understanding
- Cost Benefit Analysis



Activities of Data Scientists

TABLE 2. ACTIVITIES THAT PARTICIPANTS STATED THEY DID THEMSELVES (■) OR MANAGED (□)

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Collecting	Building the data collection platform	■			■				■			■		■	□		
	Injecting telemetry	■	□		■				■		□	■		■	□		
	Building the experimentation platform	■													□		
Analyzing	Data merging and cleaning	■	■	■	■	■	■	■	■	■	□	■		■	□		
	Sampling	■	■	■	■	■	■	■		■	□	■	■	■	□	■	■
	Shaping, feature selection		■	■	■	■	■	■			□		■	■	□	■	■
	Defining sensible metrics	■			■	■	■	■			□	■		■	□		■
	Building predictive models		■	■		■	■	■		■	□		■	■	□	■	■
	Defining ground truth							■		■			■	■	□	■	■
	Hypothesis testing		■	■		■	■				□				□		■
Using and Disseminating	Operationalizing models						■	■		■	□		■	■	□	■	
	Defining actions and triggers									■	■	■		■	□		
	Applying insights/models to business	■	■	■	■	■				■	■	■	■	■	□	■	■

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	Sampling	■	■	■	■	■	■	■		■	□	■	■	■	□	■	■
	Shaping, feature selection		■	■	■	■	■	■			□		■	■	□	■	■
	Defining sensible metrics	■			■	■	■	■			□	■		■	□		■
	Building predictive models		■	■		■	■	■		■	□		■	■	□	■	■
	Defining ground truth							■		■			■	■	□	■	■
	Hypothesis testing		■	■		■	■				□				□		■
Using and Disseminating	Operationalizing models						■	■		■	□		■	■	□	■	
	Defining actions and triggers									■	■	■		■	□		
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	Sampling	■	■	■	■	■	■	■		■	□	■	■	■	□	■	■
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	Defining sensible metrics	■			■	■	■	■			□	■		■	□		■
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	Sampling	■	■	■	■	■	■	■		■	□	■	■	■	□	■	■
	Shaping, feature selection		■	■	■	■	■	■			□		■	■	□	■	■
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	Hypothesis testing		■	■		■	■				□				□		■
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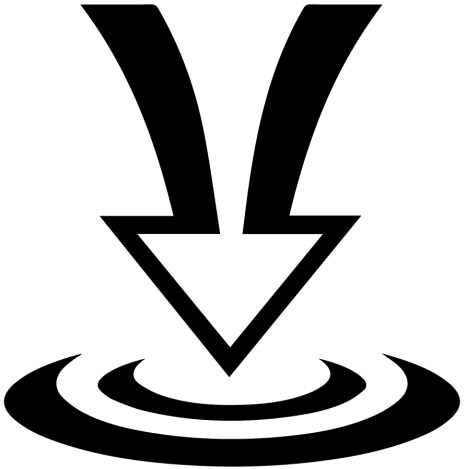
	Applying insights/models to business	■	■	■	■	■				■	■	■	■	■	□	■	■

Impact

- New Features
  - Repetitive sequences of **user action**
- Deprecate unused features
  - Large amount of code of features that **nobody used**
- Defect prediction
  - **Releases earlier** than expected

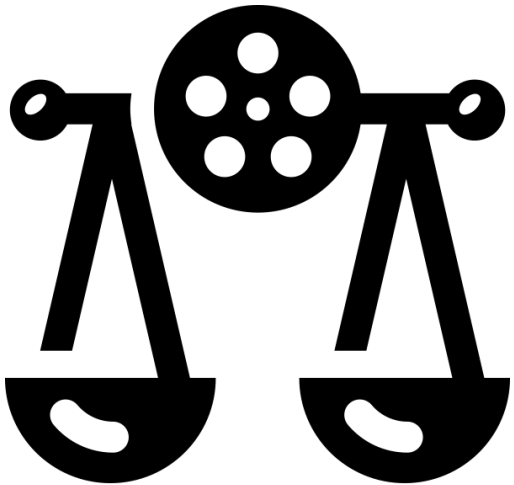


Data Scientists Working Styles

- Insight Providers
  - Generate **insights** to support and guide managers decisions
- Modeling Specialists
  - Build **predictive models** (new features or make decisions)
- Platform Builders
  - Build **data** engineering **platform**
- Polymaths
  - “Do it all”
- Team Leaders

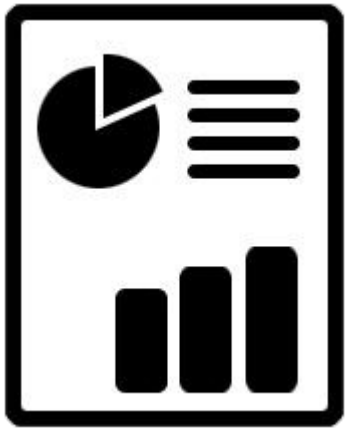
Implications

- **Research**
  - New data available, new role in development teams...
- **Practice**
  - Monetization, new job positions...
- **Education**
  - New skills to be taught



Conclusion

- Data Scientists **Characterization**
  - Activities, problems, roles, background, working style...
- Redesigning Experiments
  - Real user data and report results
- **Future Work**: large scale survey



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