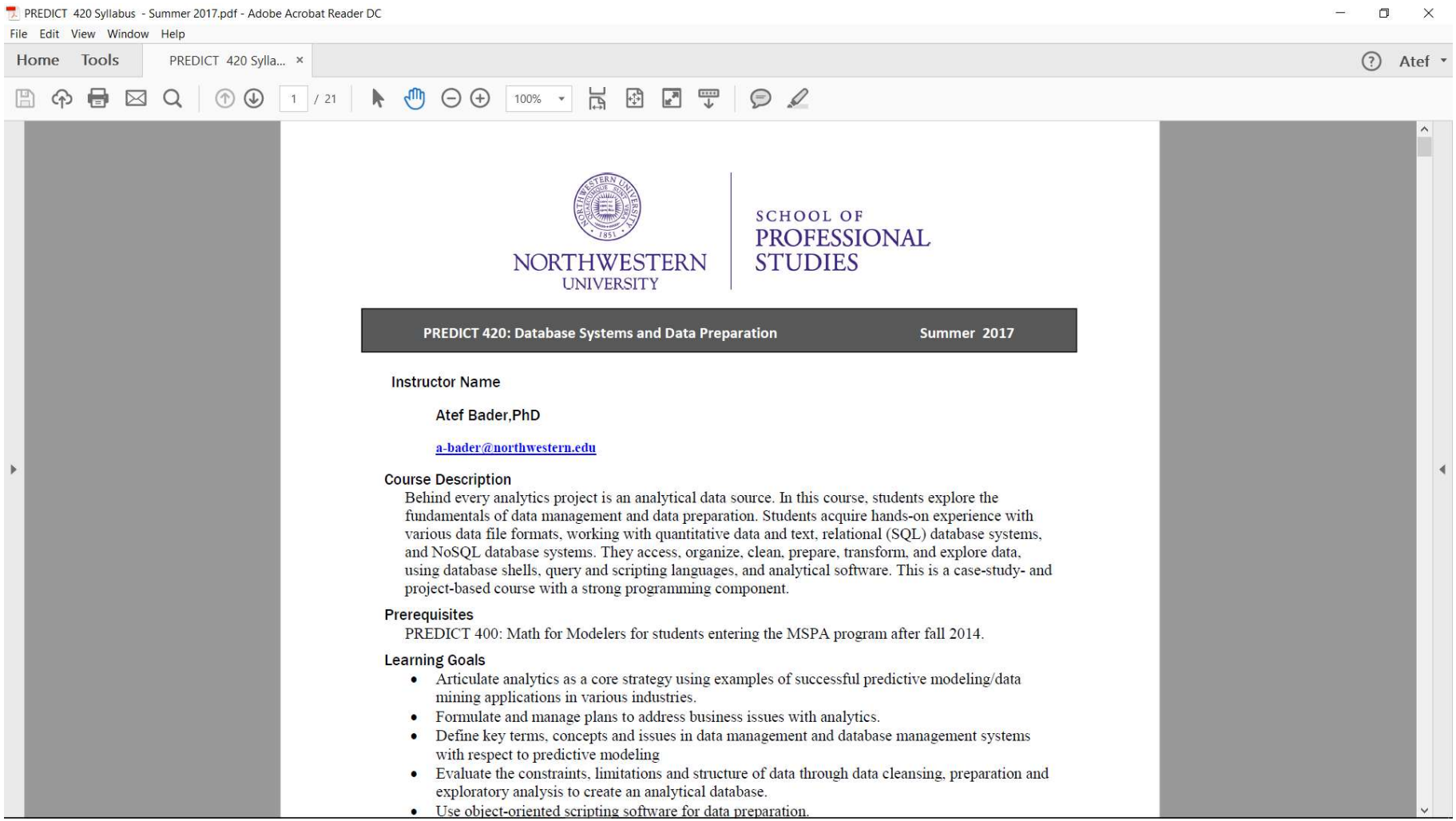
PREDICT 420

Atef Bader, PhD

Agenda

- Syllabus
- Canvas – Course Homepage
- FAQ
- Course Topics - Walkthrough
- Python/Canopy tool
- Exercise #1 Practice
- What you need to submit for Exercise #1 on Canvas?

Syllabus



PREDICT 420 Syllabus - Summer 2017.pdf - Adobe Acrobat Reader DC

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NORTHWESTERN UNIVERSITY | SCHOOL OF PROFESSIONAL STUDIES

PREDICT 420: Database Systems and Data Preparation **Summer 2017**

Instructor Name

Atef Bader,PhD

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Course Description

Behind every analytics project is an analytical data source. In this course, students explore the fundamentals of data management and data preparation. Students acquire hands-on experience with various data file formats, working with quantitative data and text, relational (SQL) database systems, and NoSQL database systems. They access, organize, clean, prepare, transform, and explore data, using database shells, query and scripting languages, and analytical software. This is a case-study- and project-based course with a strong programming component.

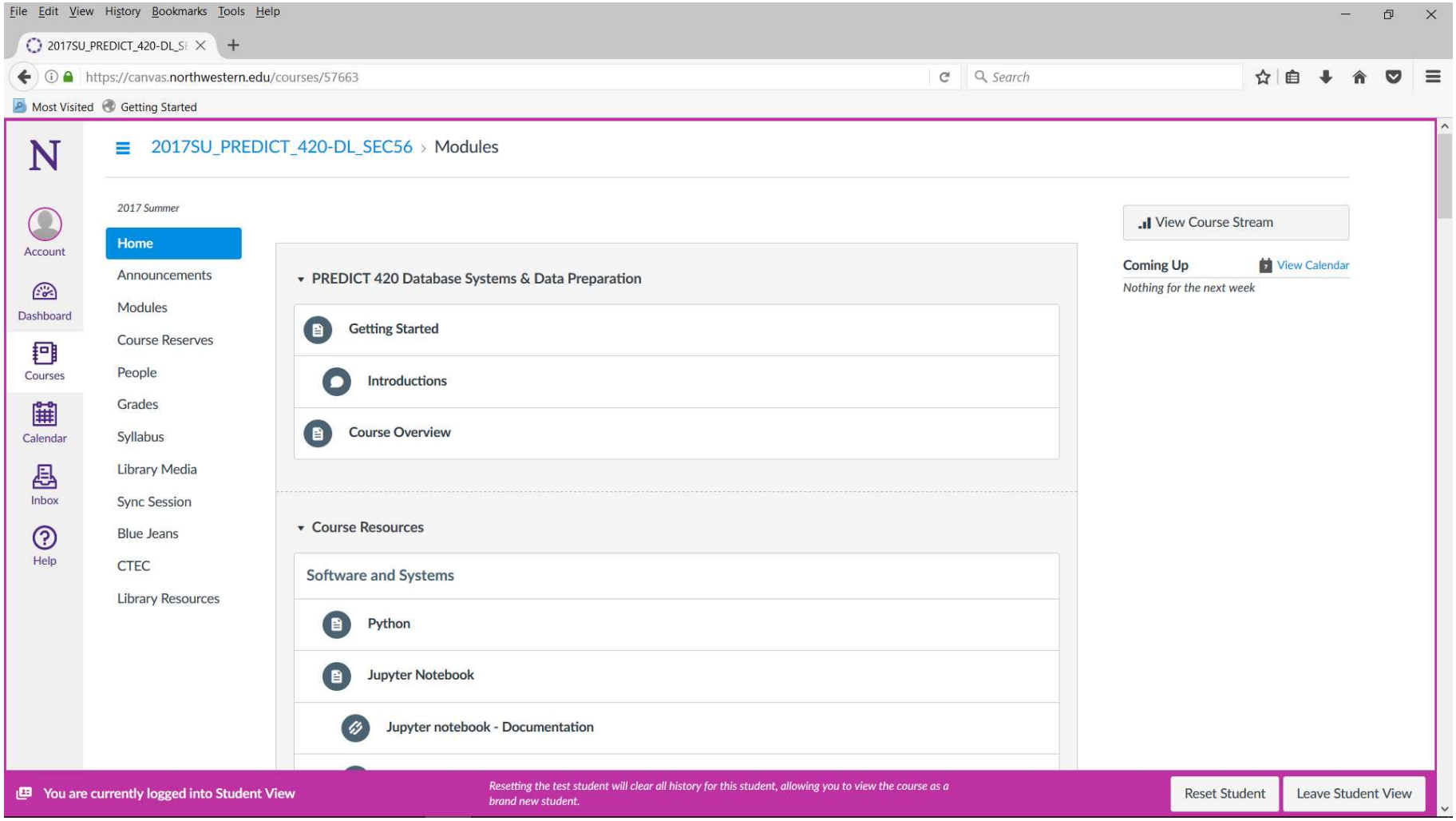
Prerequisites

PREDICT 400: Math for Modelers for students entering the MSPA program after fall 2014.

Learning Goals

- Articulate analytics as a core strategy using examples of successful predictive modeling/data mining applications in various industries.
- Formulate and manage plans to address business issues with analytics.
- Define key terms, concepts and issues in data management and database management systems with respect to predictive modeling
- Evaluate the constraints, limitations and structure of data through data cleansing, preparation and exploratory analysis to create an analytical database.
- Use object-oriented scripting software for data preparation.

Canvas Course Homepage Layout



FAQ

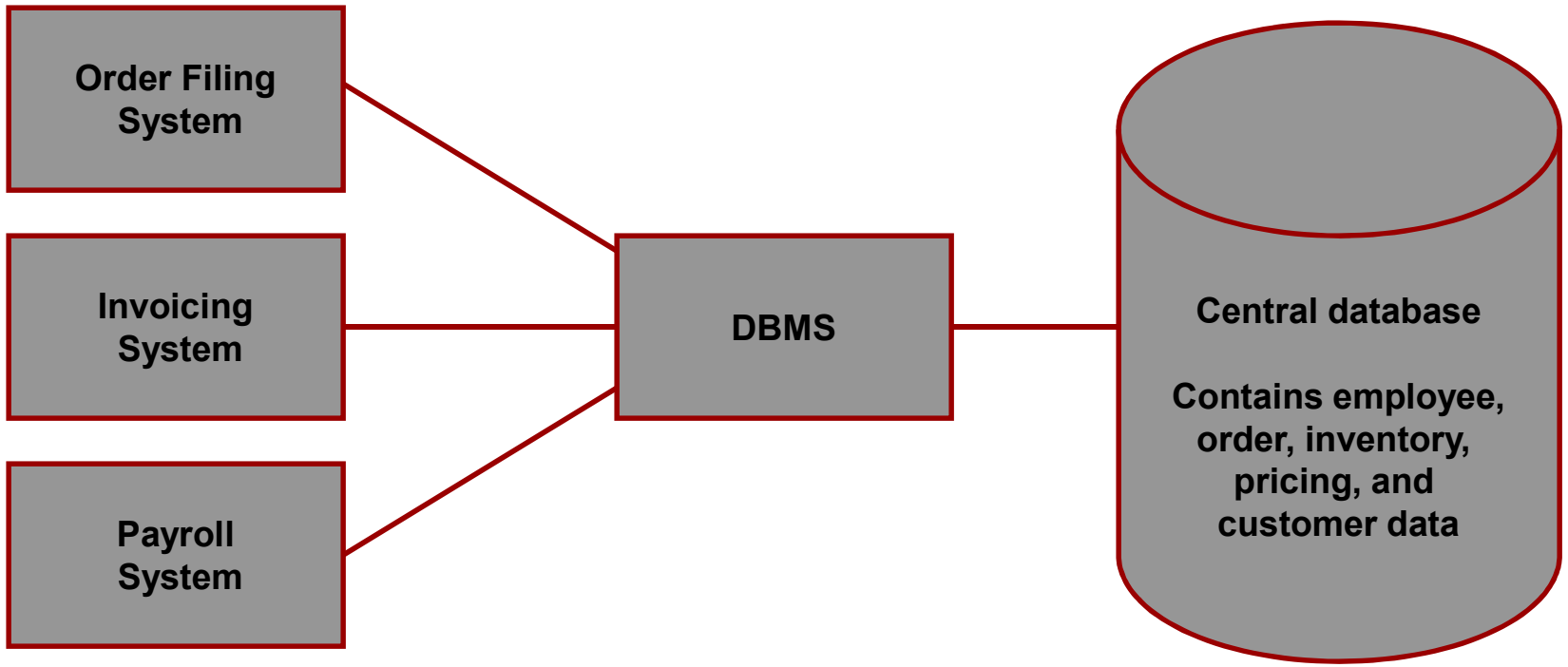
- What is this class about?
  - Explore the fundamentals of data management and data preparation
  - Structured data vs. Unstructured data
  - Relational Database & File Processing
  - Python, SQL/NoSQL, Postgres
- Where I can find the weekly recordings for the sync sessions?
  - All sync sessions are recorded on weekly basis and posted on Canvas by 11:59pm On Mondays
- Where can I find the due dates for assignments?
  - Canvas/Syllabus

Data

- Data could be
  1. Structured
     - Employee record, Product, Order, Transaction, etc.
  2. Unstructured
     - Email, Tweets, blogs, social chats, reviews, etc.

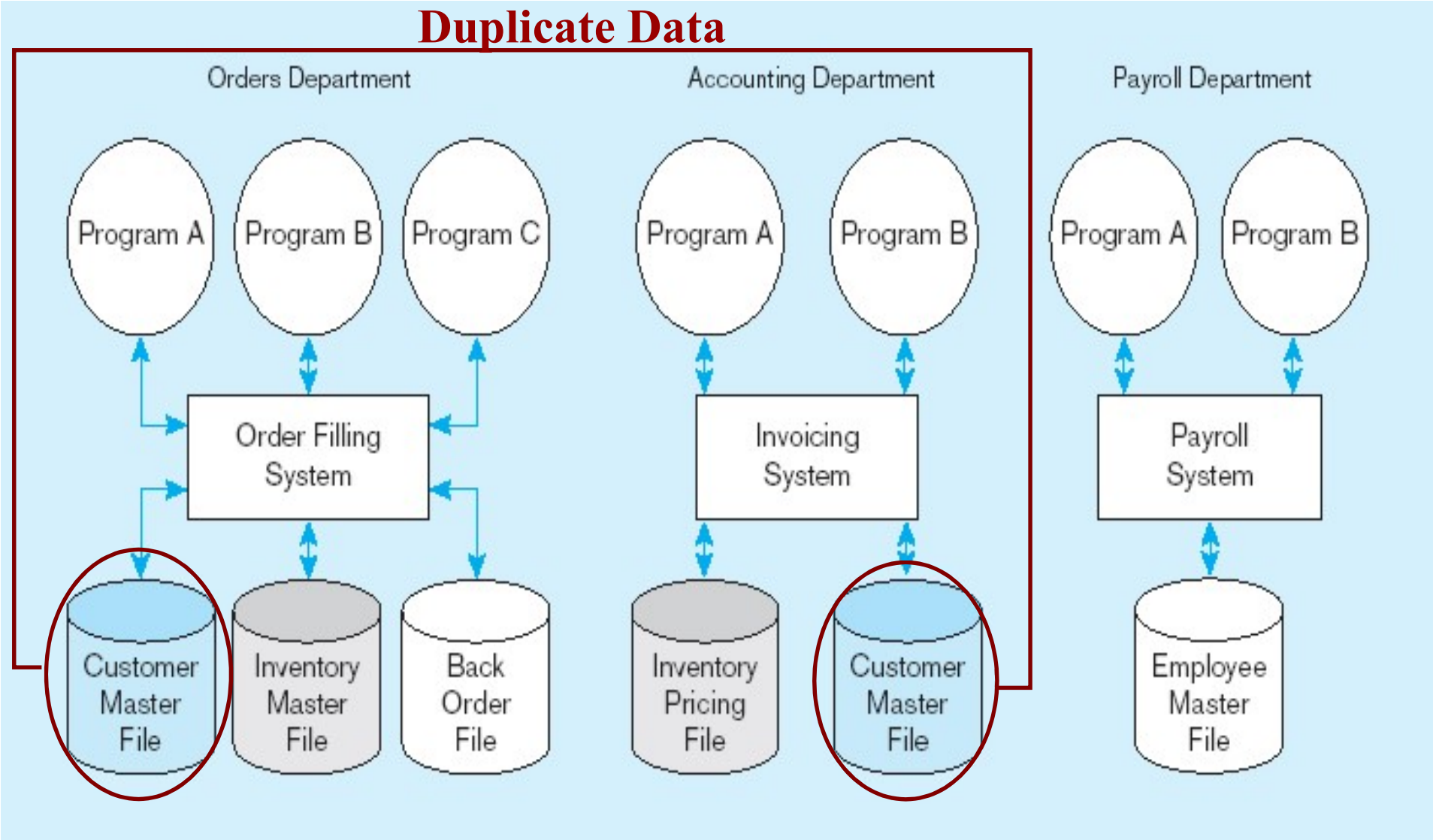
Database Management System

A software system that is used to create, maintain, and provide controlled access to user databases



DBMS manages data resources like an operating system manages hardware resources

File Processing Systems



Disadvantages of File Processing

- **Program-Data Dependence**
  - All programs maintain metadata for each file they use
- **Duplication of Data**
  - Different systems/programs have separate copies of the same data
- **Limited Data Sharing**
  - No centralized control of data
- **Lengthy Development Times**
  - Programmers must design their own file formats
- **Excessive Program Maintenance**
  - 80% of information systems budget

Advantages of the Database Approach

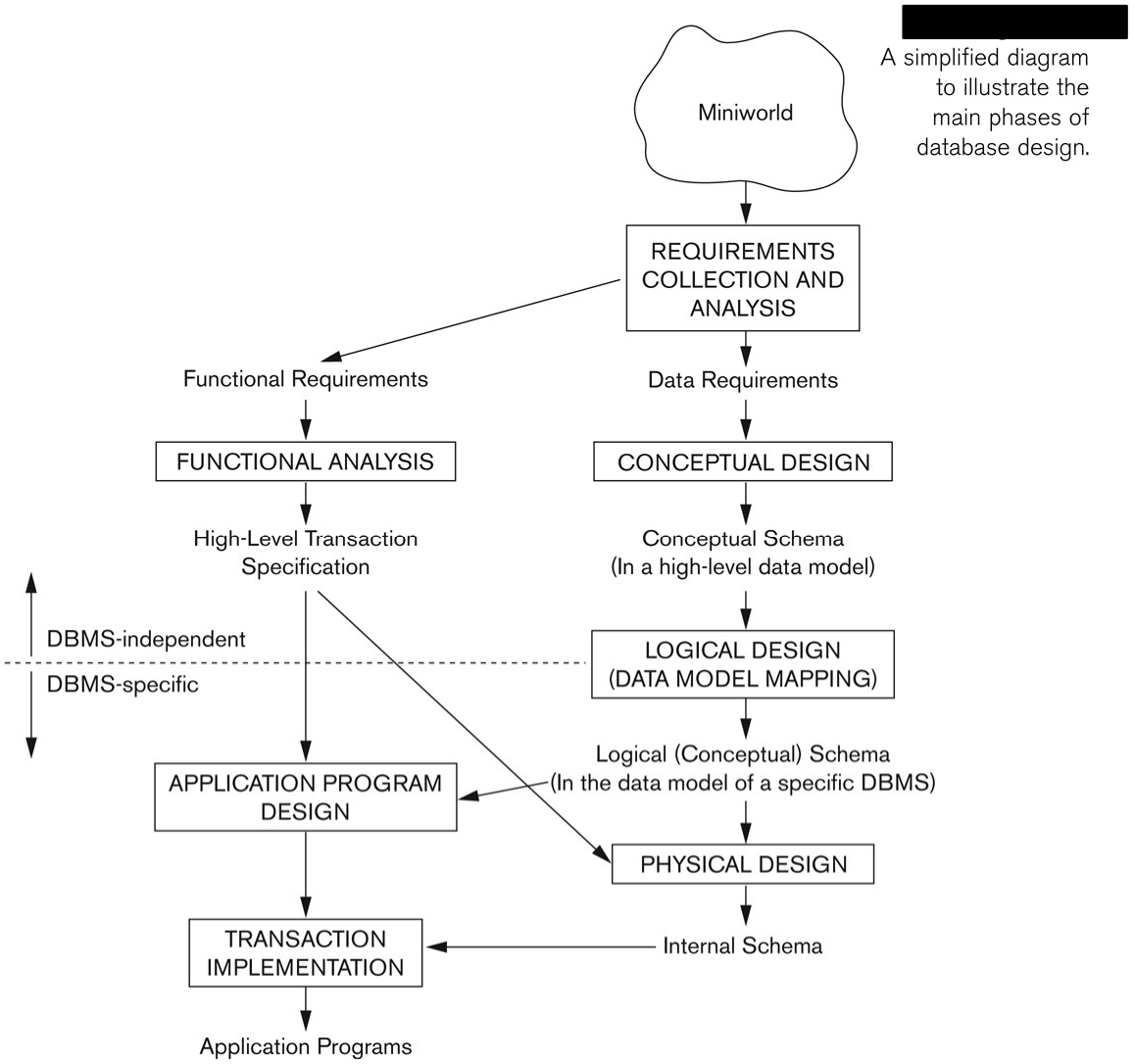
- Program-data independence
- Planned data redundancy
- Improved data consistency
- Improved data sharing
- Increased application development productivity
- Enforcement of standards
- Improved data quality
- Improved data accessibility and responsiveness
- Reduced program maintenance
- Improved decision support

Old School for Data vs New School for Data

- **The Old School for Data**
  - Unstructured Data (Megabytes/Gigabytes
  - Structured Data → Relations (Tables)
  - File Processing → RDBMS

- **The New School for Data**
  - Social Media, Mobile computing, Cloud computing and the internet produce Exabytes of primarily Unstructured Data on a daily basis
  - Unstructured data has many potentially useful patterns (the case for Big Data Analytics)
  - Structured Data still in use
  - File Processing pushed back to front seat
  - RDBMS still in use

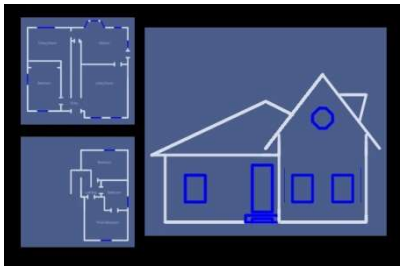
Overview of Database Design Process



A simplified diagram to illustrate the main phases of database design.

How to build Database Application?

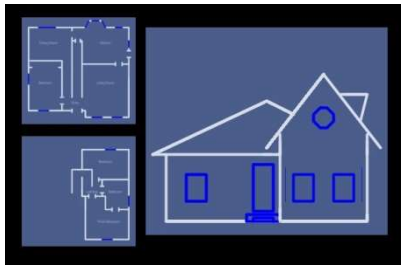
1. Blue print
2. Tools
3. Construction
4. House




1. Entity Relationship Diagram
2. SQL/UML/FD
3. Relations
4. Tables

How to build Database Application?

1. Entity Relationship Diagram
   - Entities
   - Attributes
   - Relationships



How to build Database Application?

2. SQL/UML/FD
   - SQL
     - DDL – Data Definition
     - DML – Data Manipulation
   - UML
     - Notation for ER Diagram
   - FD (Functional Dependency)
     - Update Anomalies
     - Delete Anomalies
     - Insert Anomalies

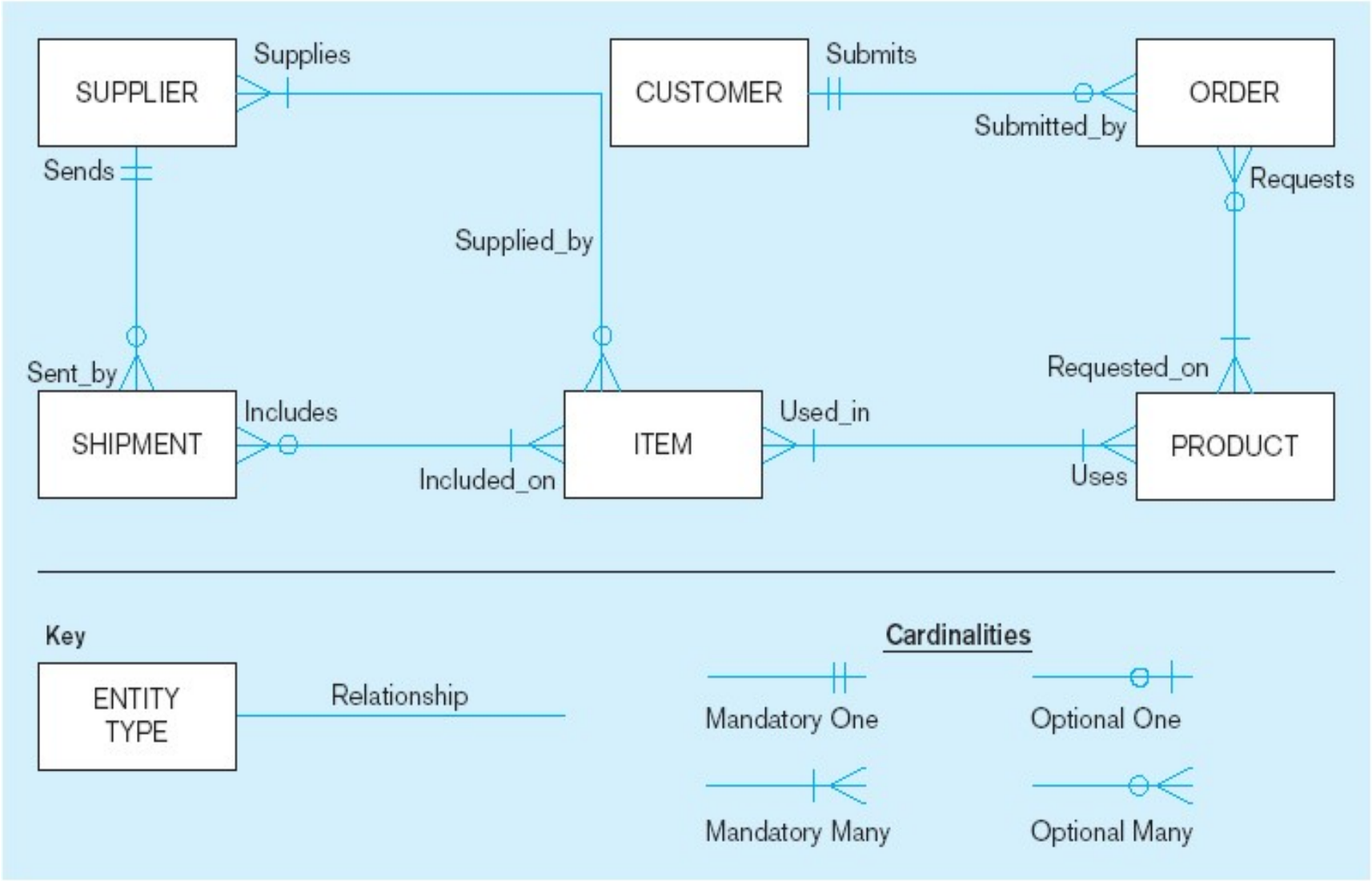
How to build Database Application?

2. Relations
   - Normalization
   - Normal Forms
     - 1st Normal Form
     - 2nd Normal Form
     - 3rd Normal Form
     - BCNF

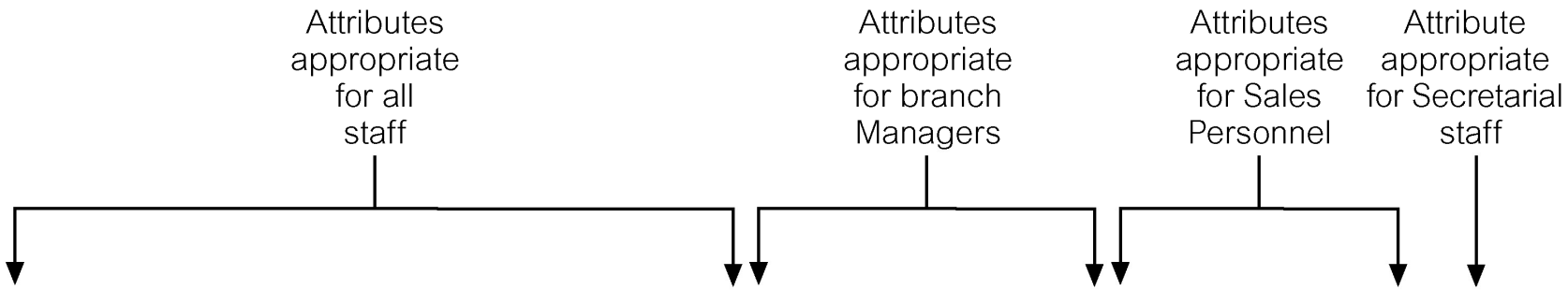
How to build Database Application?

4. Tables
   - Rows
   - Columns
   - Primary keys
   - Foreign Keys
   - Constraints

Sample E-R Diagram

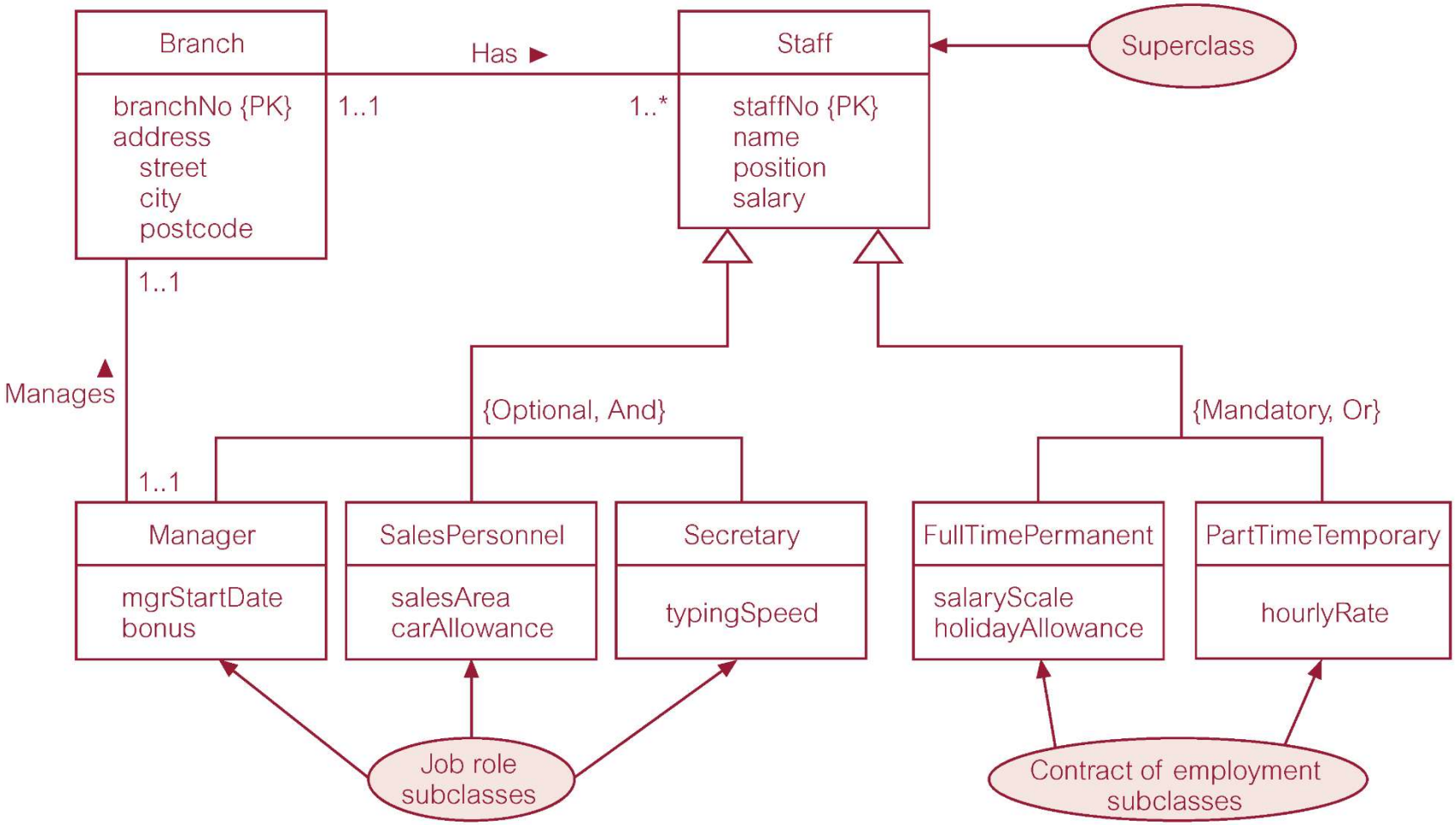


AllStaff relation holding details of all staff



staffNo	name	position	salary	mgrStartDate	bonus	sales Area	car Allowance	typing Speed
SL21	John White	Manager	30000	01/02/95	2000			
SG37	Ann Beech	Assistant	12000					
SG66	Mary Martinez	Sales Manager	27000			SA1A	5000	
SA9	Mary Howe	Assistant	9000					
SL89	Stuart Stern	Secretary	8500					100
SL31	Robert Chin	Snr Sales Asst	17000			SA2B	3700	
SG5	Susan Brand	Manager	24000	01/06/91	2350			

Specialization/generalization of Staff entity into job roles and contracts of employment



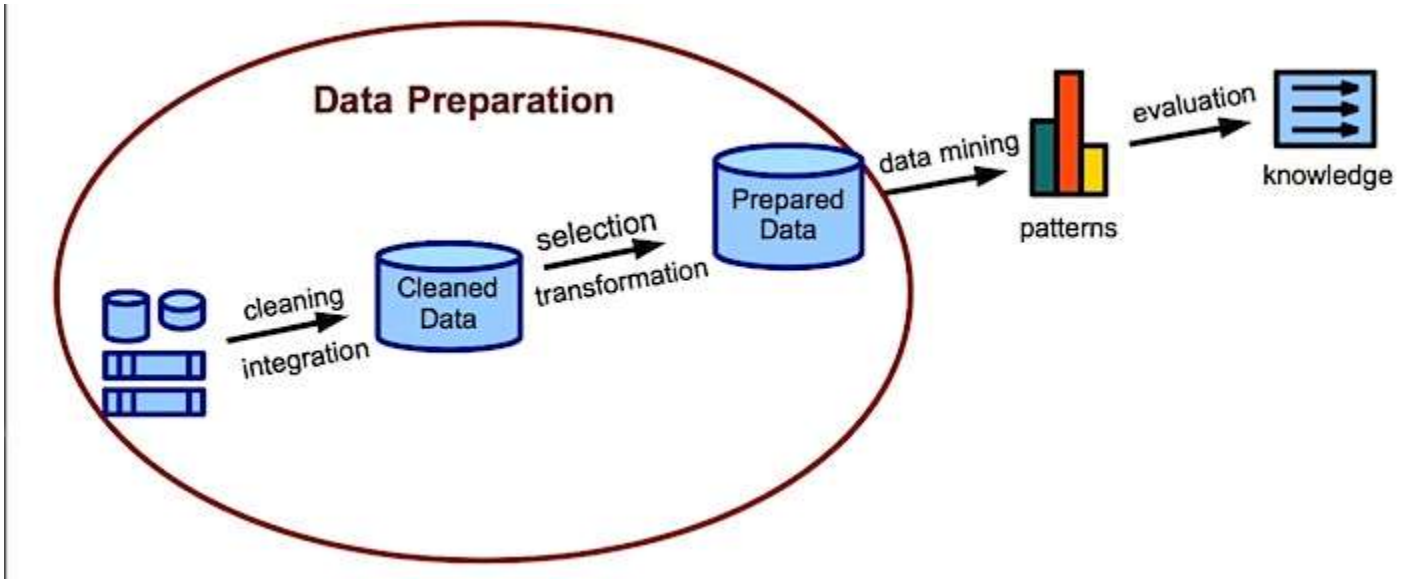
Data , what is in the name?

- Different terms used and interpreted differently:
  1. Data Preparation/Preprocessing
  2. Data Analysis
  3. Data Analytics
  4. Data Mining
  5. Data Processing

- Lets review each one of these terms …

Data , what is in the name?

1. Data Preparation/Preprocessing
   - Data preparation (or data preprocessing) in this context means manipulation of data into a form suitable for further analysis and processing.



Data , what is in the name?

2. Data Analysis
   - Analysis proceeds design
   - **We say we do analysis to discover basic elements, relationships between the elements, and operations on the elements**
   - How we do analysis to design and build a database system for example?
   - For example,
     - a company has employees, and offices
     - Company has name and budget
     - Office has number and address
     - Employee has an ID, name, salary
     - We want to be able to get a list of employees
     - We want to get a list of offices assigned to employees

Data , what is in the name?

3. Data Analytics
   - Is the science of examining raw data with the purpose of drawing conclusions about that information.
   - **Data Analytics use statistics, data mining, computer technology, etc to draw an inference**
   - Data analytics focuses on inference, the process of deriving a conclusion based solely on what is already known
   - The term "analytics" has been used by many business intelligence (BI) software vendors as a buzzword to describe quite different functions
   - Banks and credit cards companies, for instance, analyze withdrawal and spending patterns to prevent fraud or identity theft. Ecommerce companies examine Web site traffic or navigation patterns to determine which customers are more or less likely to buy a product or service based upon prior purchases or viewing trends

Data , what is in the name?

4. Data Mining
   - Is about sorting through large **data sets** using **software tools** and **Machine Learning algorithms** to identify **useful patterns** , **hidden knowledge**, and **hidden relationships**.

Data , what is in the name?

5. Data Processing
   - Apply Operations on data. (Addition, Multiplication, String tokenizer, etc.)

Big Data - Prime Time

"Big Data" is Growing

- 383+ Million Twitter accounts
- 835+ Million Facebook subscribers
- 1.2+ Billion Mobile Web users
- Machine and sensor data
- Over 6 million OnStar subscribers

This data as of 2012

Big Data - Prime Time

- People spend over 500 billion minutes per month on Facebook.
- YouTube receives more than 2 billion viewers per day
- More than 30 billion pieces of content are shared each month on Facebook.
- Every minute, 24 hours of video is uploaded to YouTube
- As of December 2010, the average number of tweets sent per day was 110 million

REFERENCE : Social Media Analytics: Data Mining Applied to Insurance Twitter Posts Roosevelt C. Mosley Jr., FCAS, MAAA

Big Data - Prime Time

- What Walmart reported … BENTONVILLE, Ark., Nov. 23, 2012 – Today, Walmart U.S. reported its best ever Black Friday events.
  - The work of our associates is even more impressive when you consider they served approximately 22 million customers on Thursday.
  - Walmart's Black Friday plan included three events this year at 8 p.m., 10 p.m. and 5 a.m. During the high traffic period from 8 p.m. through midnight, Walmart processed nearly 10 million register transactions and almost 5,000 items per second.
  - Since its events began at 8 p.m., Walmart sold more than:
    - 1.8 million towels,
    - 1.3 million televisions,
    - 1.3 million dolls and
    - 250,000 bicycles.

Big Data Prime Time

How much data you think roughly out there ?

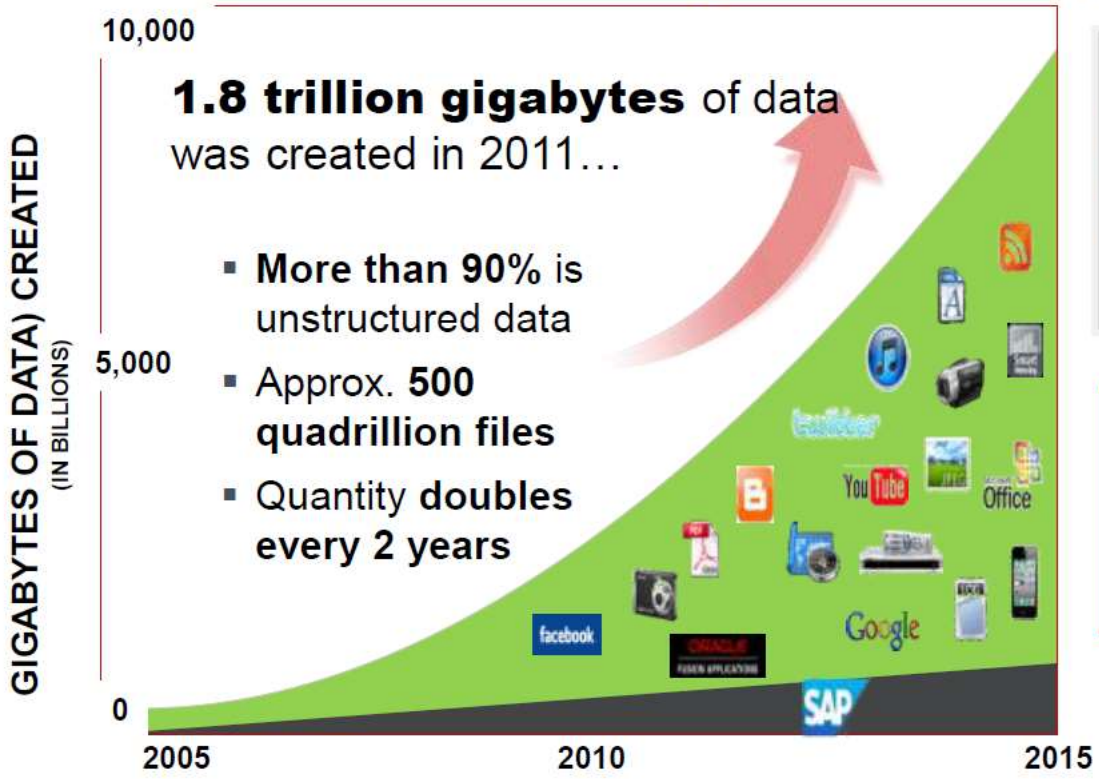
- How much data on your laptop?
- How much data on your PDA?
- How much data on your personal gmail account?
- How much data on facebook?
- How much data on twitter?
- etc. …

Decimal		
Value	Metric	
1000	kB	kilobyte
1000^2	MB	megabyte
1000^3	GB	gigabyte
1000^4	TB	terabyte
1000^5	PB	petabyte
1000^6	EB	**exabyte**
1000^7	ZB	zettabyte
1000^8	YB	yottabyte

1 EB = 1000000000000000000B = 10^{18}bytes = 1000 petabytes = 1 billion gigabytes.

Big Data Prime Time

"Big Data" ➔ "Big Data Analytics"



"There was 5 exabytes of information created between the dawn of civilization through 2003, but that much information is now created every 2 days, and the pace is increasing."

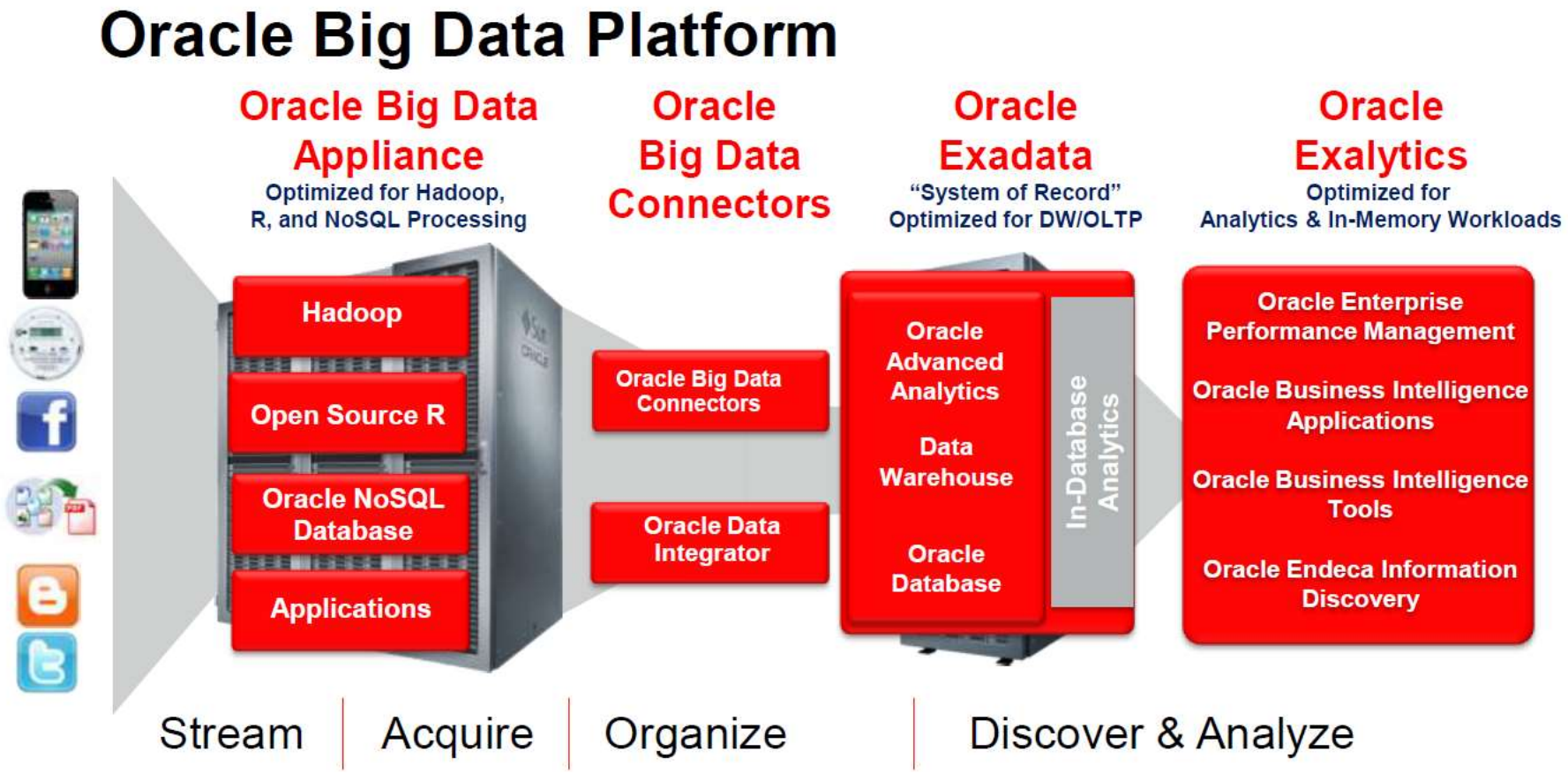
- Google CEO Eric Schmidt

Requires capability to rapidly:

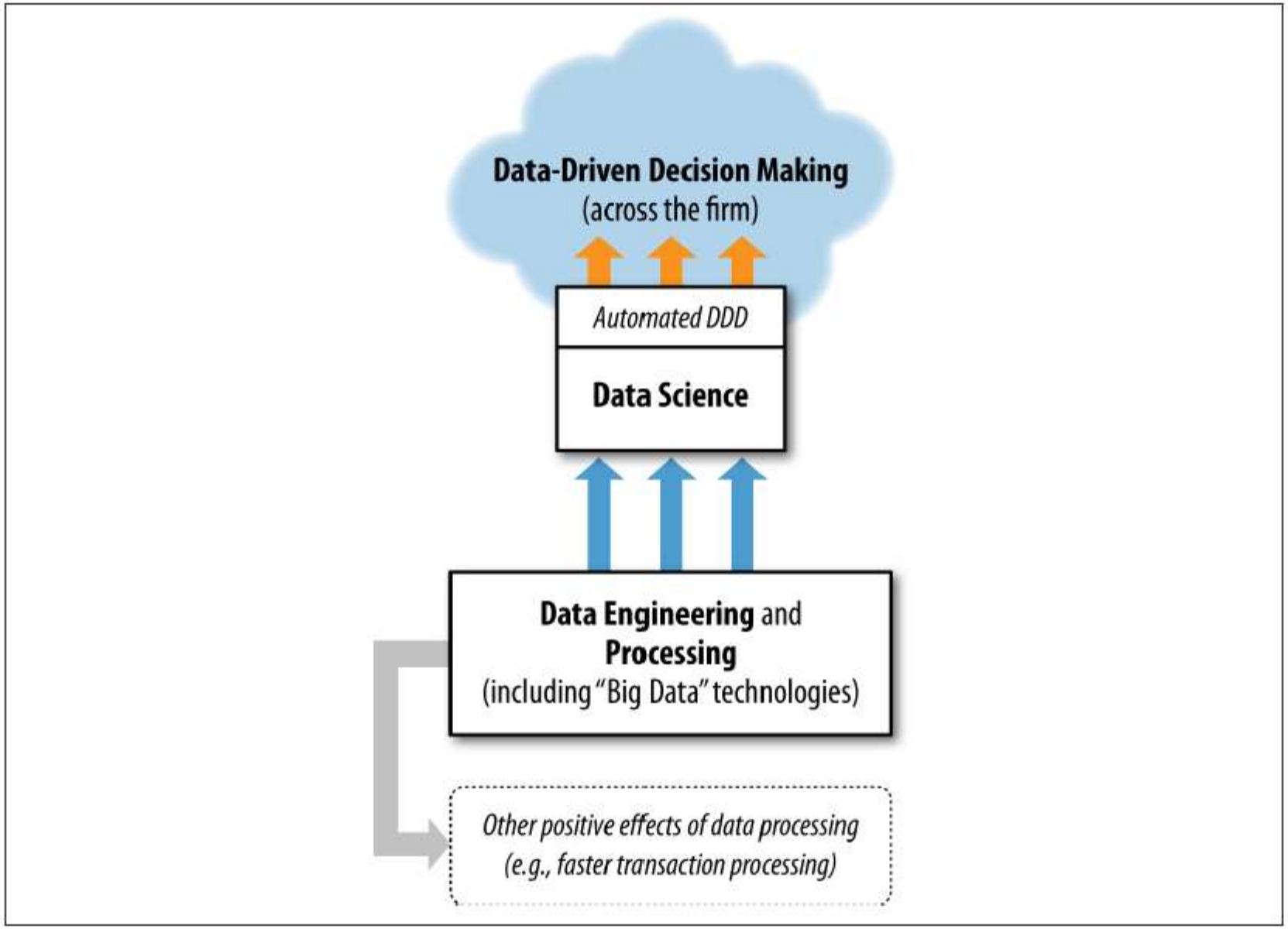
- ✓ Collect and integrate data
- ✓ ***Understand data & their relationships***
- ✓ ***Respond and take action***

Big Data Prime Time

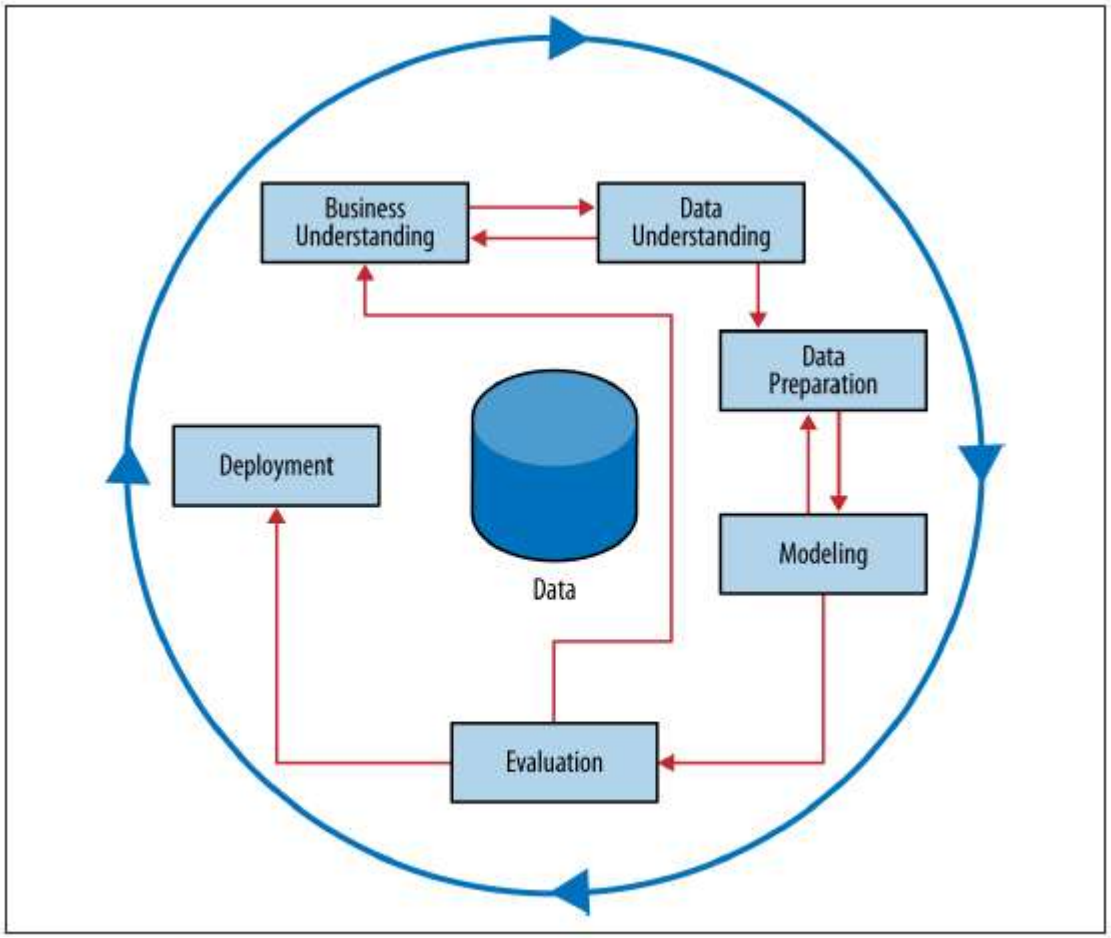
Is RDBMS and Structured data history by now? No …



The Process

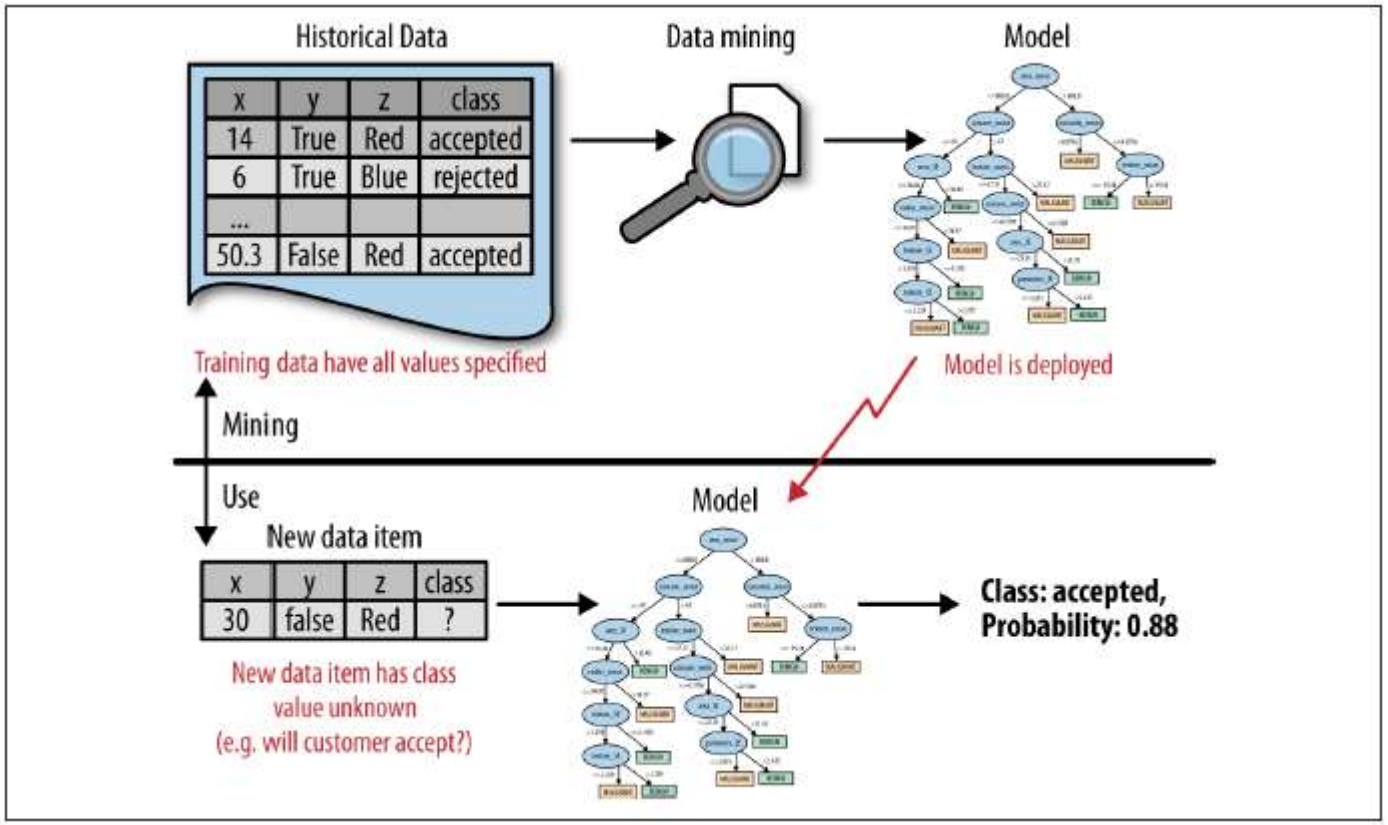

Data-Driven Decision Making
(across the firm)
Automated DDD
Data Science
Data Engineering and
Processing
(including "Big Data" technologies)
Other positive effects of data processing
(e.g., faster transaction processing)

The Process



The CRISP data mining process.

The Process


Historical Data
Data mining
Model
x
y
z
class
14
True
Red
accepted
6
True
Blue
rejected
...
50.3
False
Red
accepted
Training data have all values specified
Model is deployed
Mining
Use
Model
New data item
x
y
z
class
30
false
Red
?
New data item has class value unknown (e.g. will customer accept?)
Class: accepted, Probability: 0.88

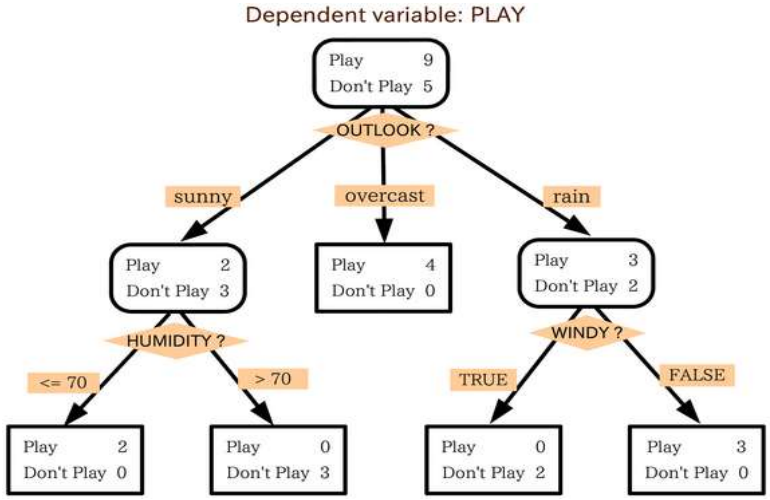
Data Format

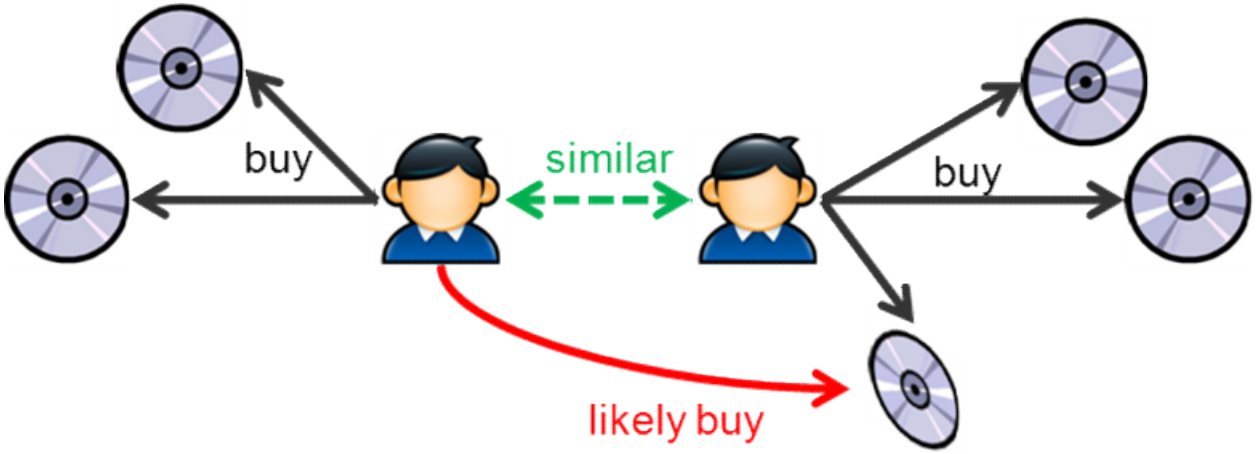
- Data is represented by ASCII code (American Standard Code for Information Interchange) which is the most widely used format.

- Data stored in Files as:
  1. Plaintext. Data is separated by comma, tab or space (plaintext). The most common extension is *.csv (comma-separated value).

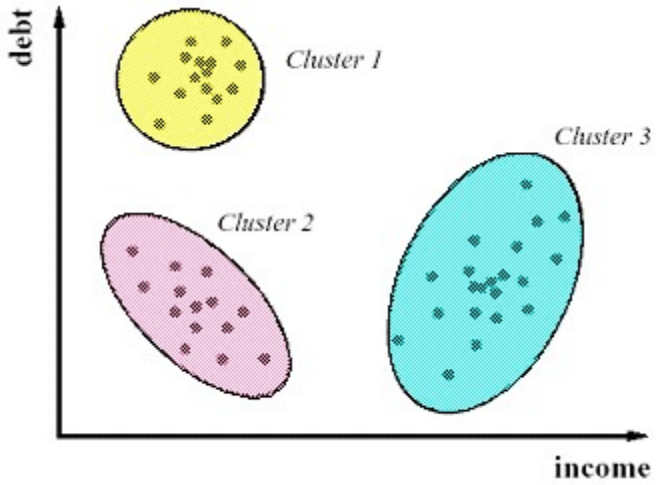
  2. Binary. Data is structured as a record by fixed blocks (formatted text)

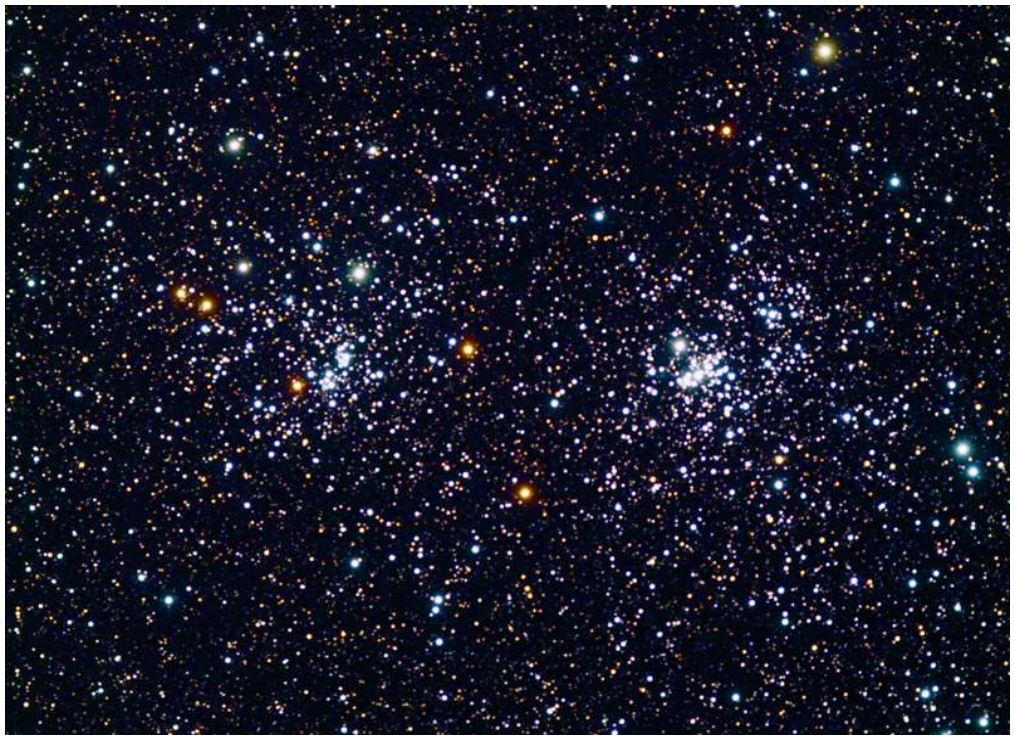
Structured and Unstructured Data …



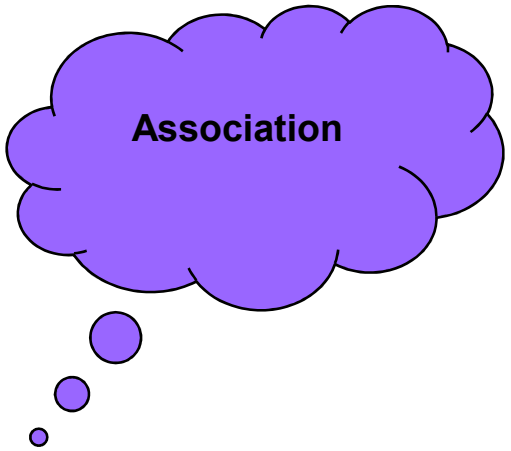


Structured and Unstructured Data …

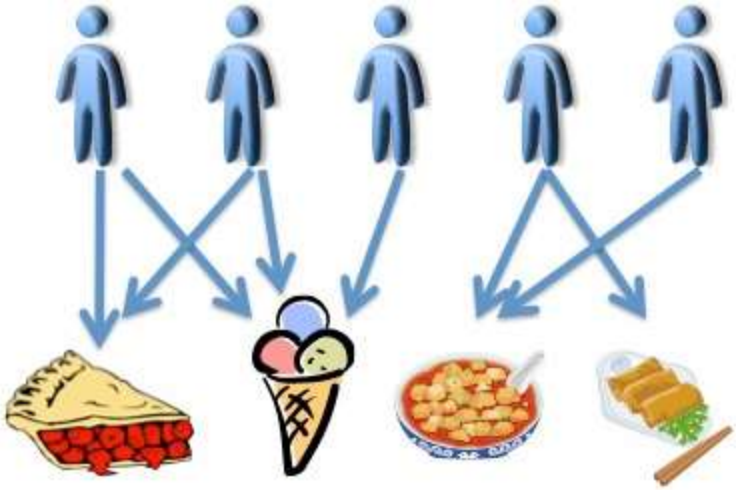


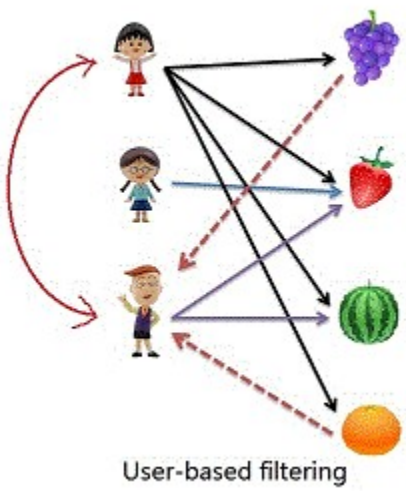


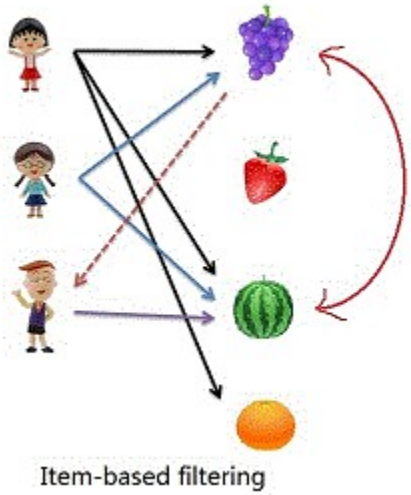
Structured and Unstructured Data …



Structured and Unstructured Data …





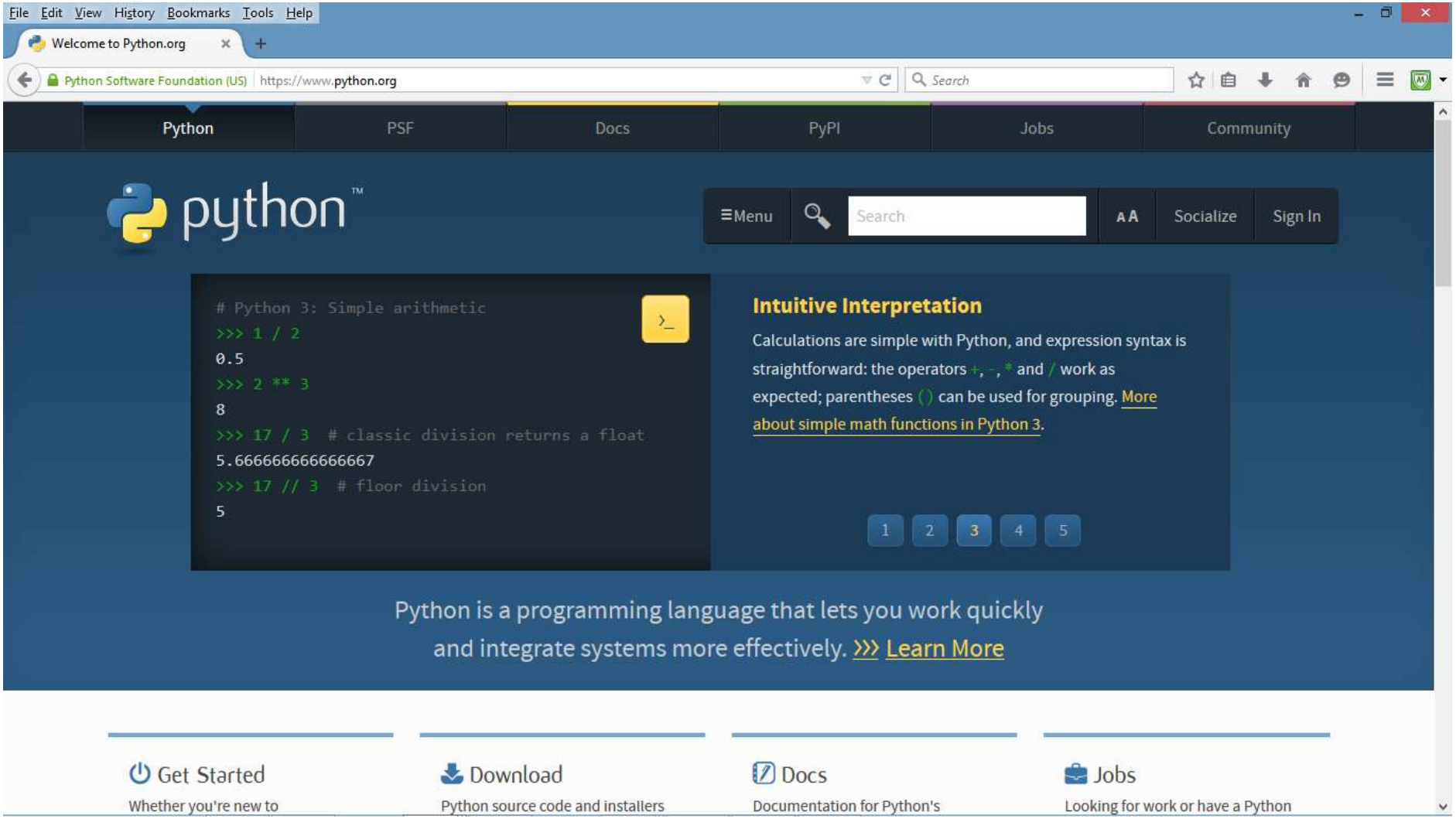


Structured and Unstructured Data …

Technologies and Tools

- Ok, I got it, data come in different variants and we need to prepare and process data …
- But what are the technologies and tools that we will use in this class

python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Welcome to Python.org
Python Software Foundation (US) https://www.python.org
Search
Python
PSF
Docs
PyPI
Jobs
Community
python
Menu
Search
AA
Socialize
Sign In
# Python 3: Simple arithmetic
>>> 1 / 2
0.5
>>> 2 ** 3
8
>>> 17 / 3 # classic division returns a float
5.666666666666667
>>> 17 // 3 # floor division
5
Intuitive Interpretation
Calculations are simple with Python, and expression syntax is straightforward: the operators +, -, * and / work as expected; parentheses () can be used for grouping. More about simple math functions in Python 3.
1
2
3
4
5
Python is a programming language that lets you work quickly and integrate systems more effectively. >>> Learn More
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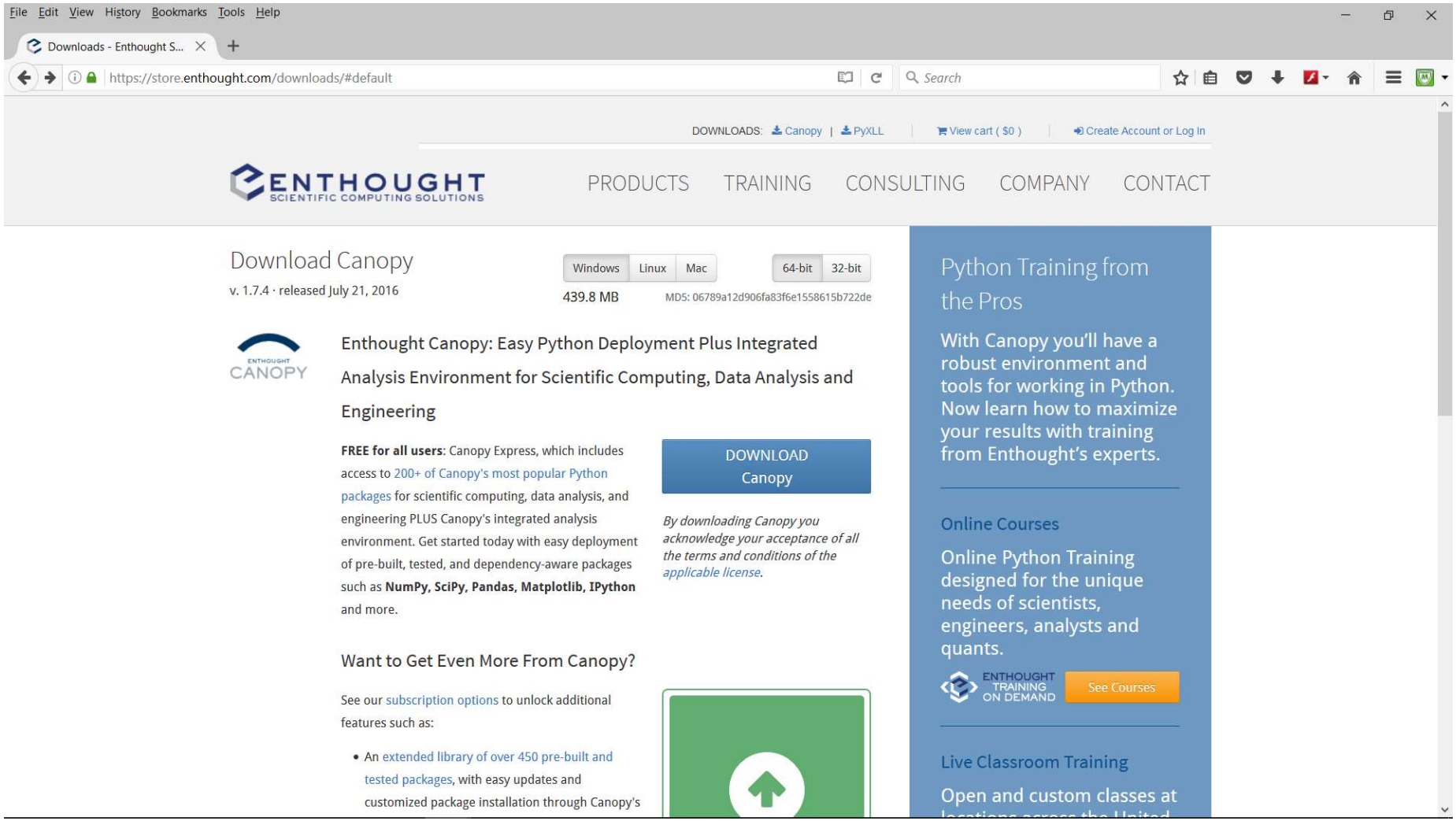
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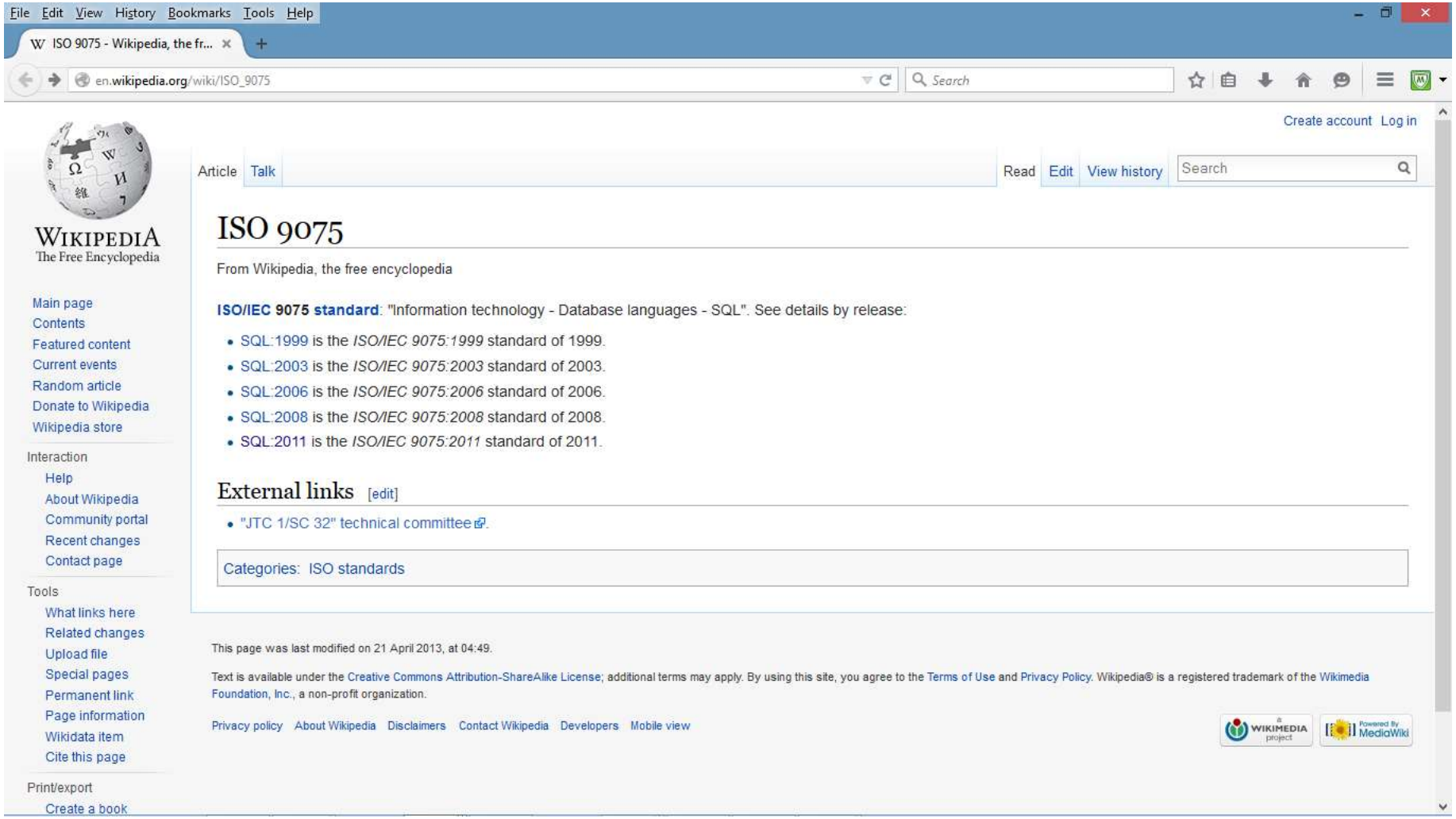
SQL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SQL:1999 is the ISO/IEC 9075:1999 standard of 1999.
SQL:2003 is the ISO/IEC 9075:2003 standard of 2003.
SQL:2006 is the ISO/IEC 9075:2006 standard of 2006.
SQL:2008 is the ISO/IEC 9075:2008 standard of 2008.
SQL:2011 is the ISO/IEC 9075:2011 standard of 2011.
External links [edit]
"JTC 1/SC 32" technical committee.
Categories: ISO standards
This page was last modified on 21 April 2013, at 04:49.
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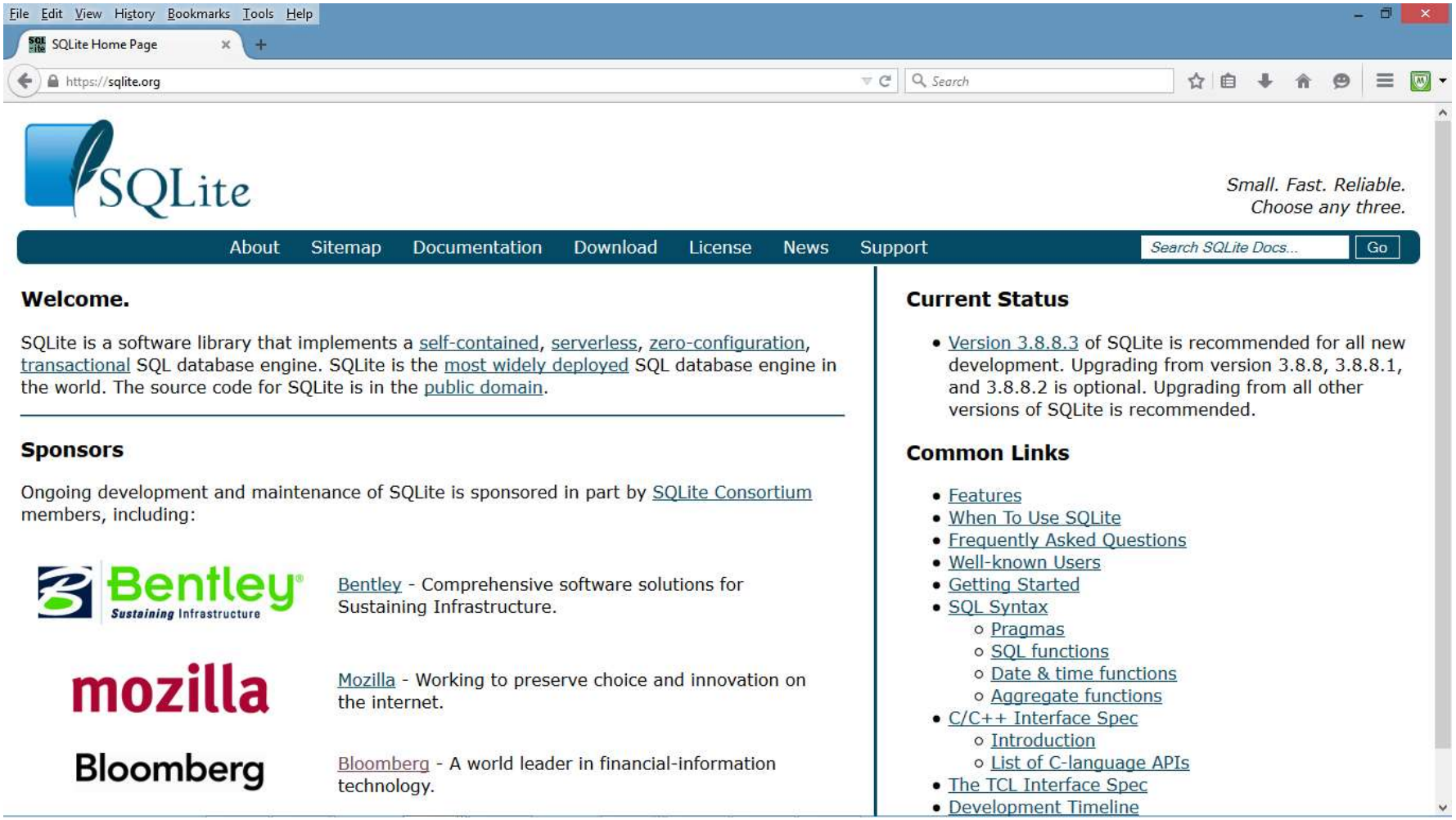
SQLite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SQLite Home Page
https://sqlite.org
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Welcome.
SQLite is a software library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine. SQLite is the most widely deployed SQL database engine in the world. The source code for SQLite is in the public domain.
Sponsors
Ongoing development and maintenance of SQLite is sponsored in part by SQLite Consortium members, including:
Bentley Sustaining Infrastructure
Bentley - Comprehensive software solutions for Sustaining Infrastructure.
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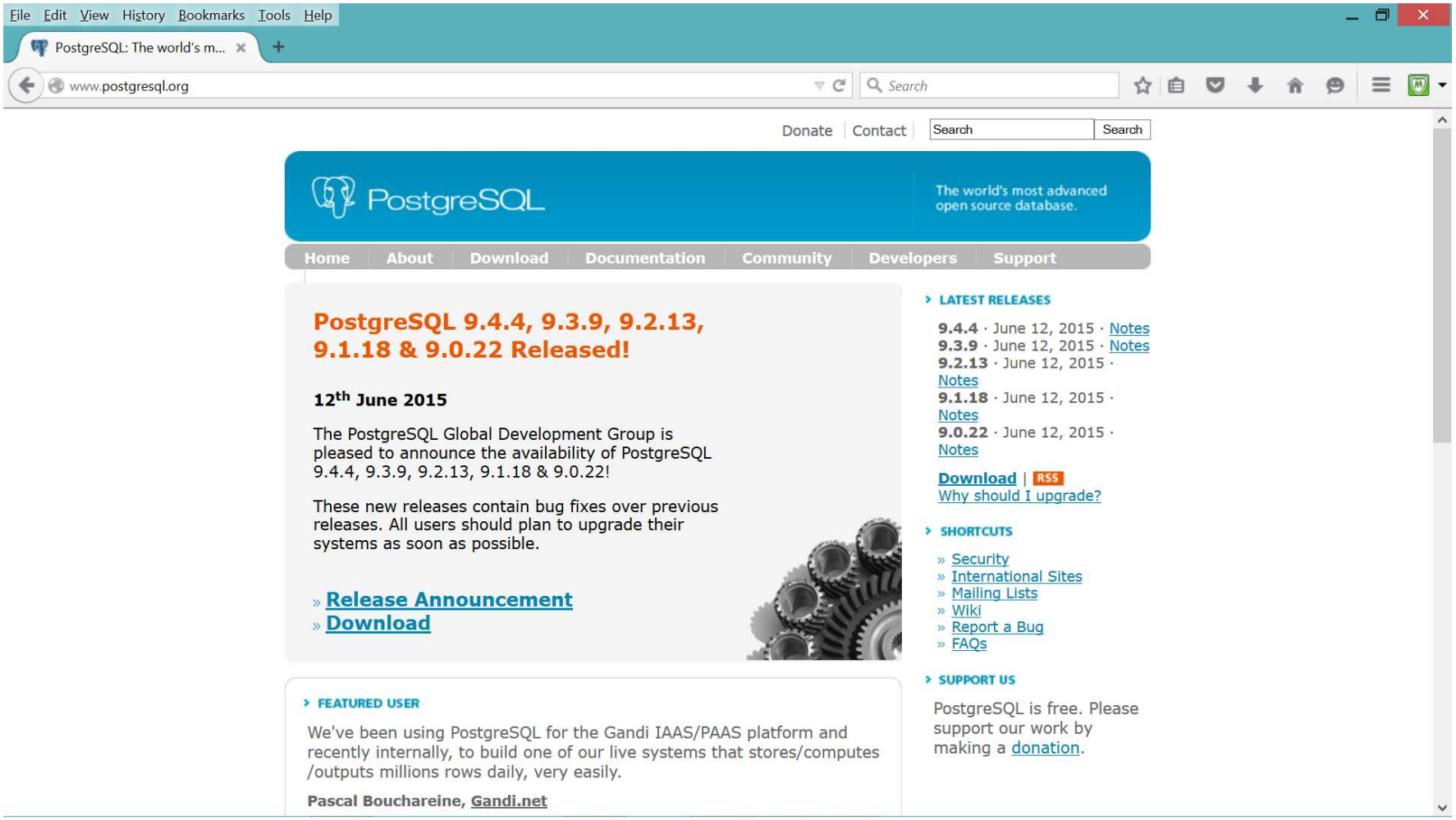
Mozilla - Working to preserve choice and innovation on the internet.
Bloomberg
Bloomberg - A world leader in financial-information technology.
Current Status
Version 3.8.8.3 of SQLite is recommended for all new development. Upgrading from version 3.8.8, 3.8.8.1, and 3.8.8.2 is optional. Upgrading from all other versions of SQLite is recommended.
Common Links
Features
When To Use SQLite
Frequently Asked Questions
Well-known Users
Getting Started
SQL Syntax
Pragmas
SQL functions
Date & time functions
Aggregate functions
C/C++ Interface Spec
Introduction
List of C-language APIs
The TCL Interface Spec
Development Timeline

PostgreSQL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PostgreSQL 9.4.4, 9.3.9, 9.2.13, 9.1.18 & 9.0.22 Released!
12th June 2015
The PostgreSQL Global Development Group is pleased to announce the availability of PostgreSQL 9.4.4, 9.3.9, 9.2.13, 9.1.18 & 9.0.22!
These new releases contain bug fixes over previous releases. All users should plan to upgrade their systems as soon as possible.
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9.4.4 · June 12, 2015 · Notes
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FEATURED USER
We've been using PostgreSQL for the Gandi IAAS/PAAS platform and recently internally, to build one of our live systems that stores/computes /outputs millions rows daily, very easily.
Pascal Bouchareine, Gandi.net
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PostgreSQL is free. Please support our work by making a donation.

Bottom Line …

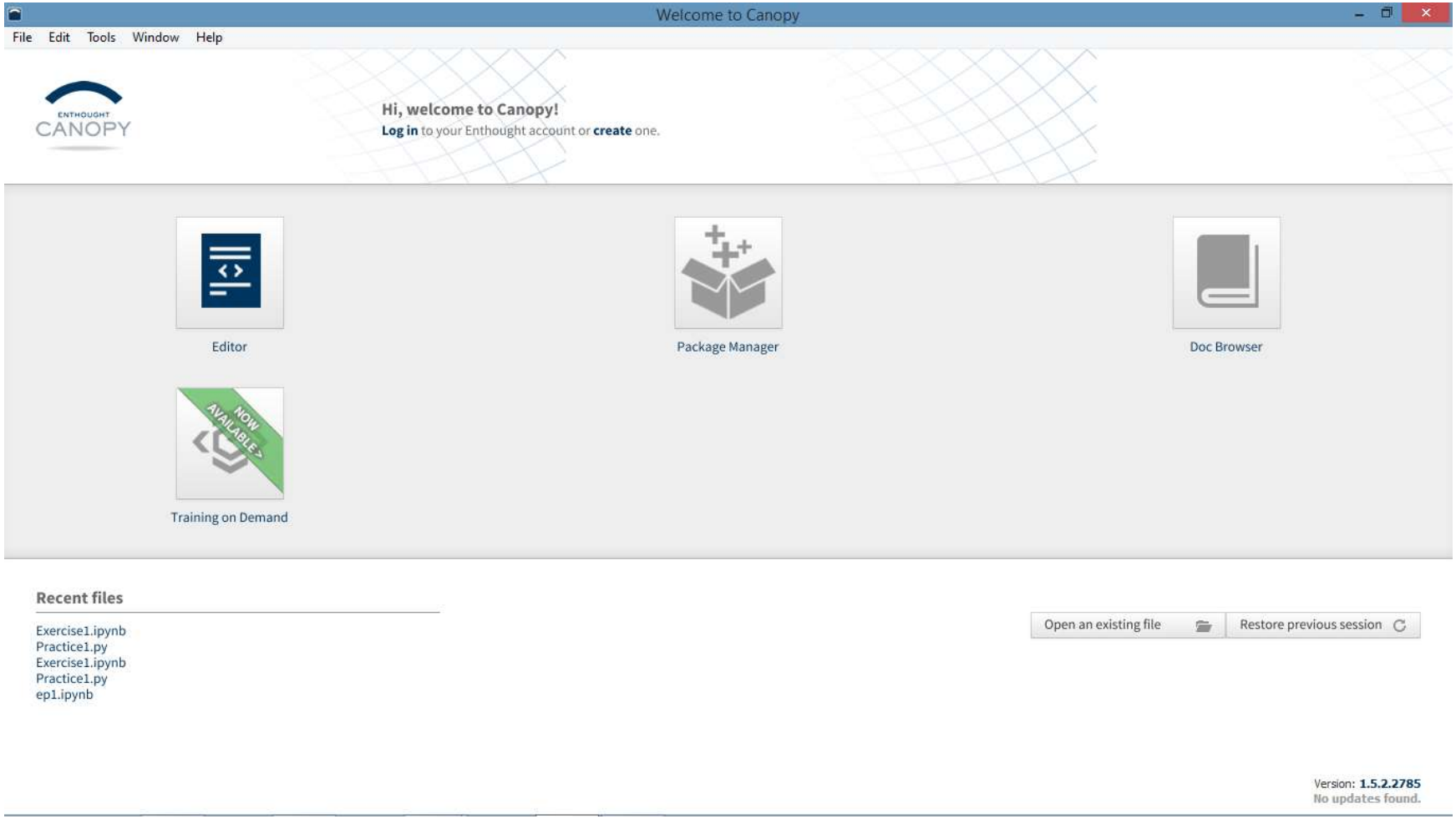
1. What you will learn in this class?
   - Learn the fundamental concepts for data management, data preparation, relational database, and file processing
   - Database Engines
   - Programming: Python and SQL

2. What you will do in this class?
   - Assignments (covering different topics)
   - Term project
   - Exercises (Python programming – data preparation/processing)

Bottom Line …

3. Logistics?
   - Participate on a weekly basis in EVERY thread posted by me in the class discussions on Canvas; deadline for every week is 11:59pm Sunday night
   - I will be posting RECORDED sync sessions almost on a weekly basis.
   - Your attendance is NOT REQUIRED for any sync session that I might hold; (NO points-credit for attending sync sessions)
   - Whenever there is a live sync session, I will be sending an email in advance
   - ALL SYNC SESSIONS ARE RECORDED so if you can't attend any LIVE sync session you can go to Canvas and watch theses recordings on your free time
   - Please do NOT discuss the class assignments on Canvas. If you have a doubt about an assignment please EMAIL me

Canopy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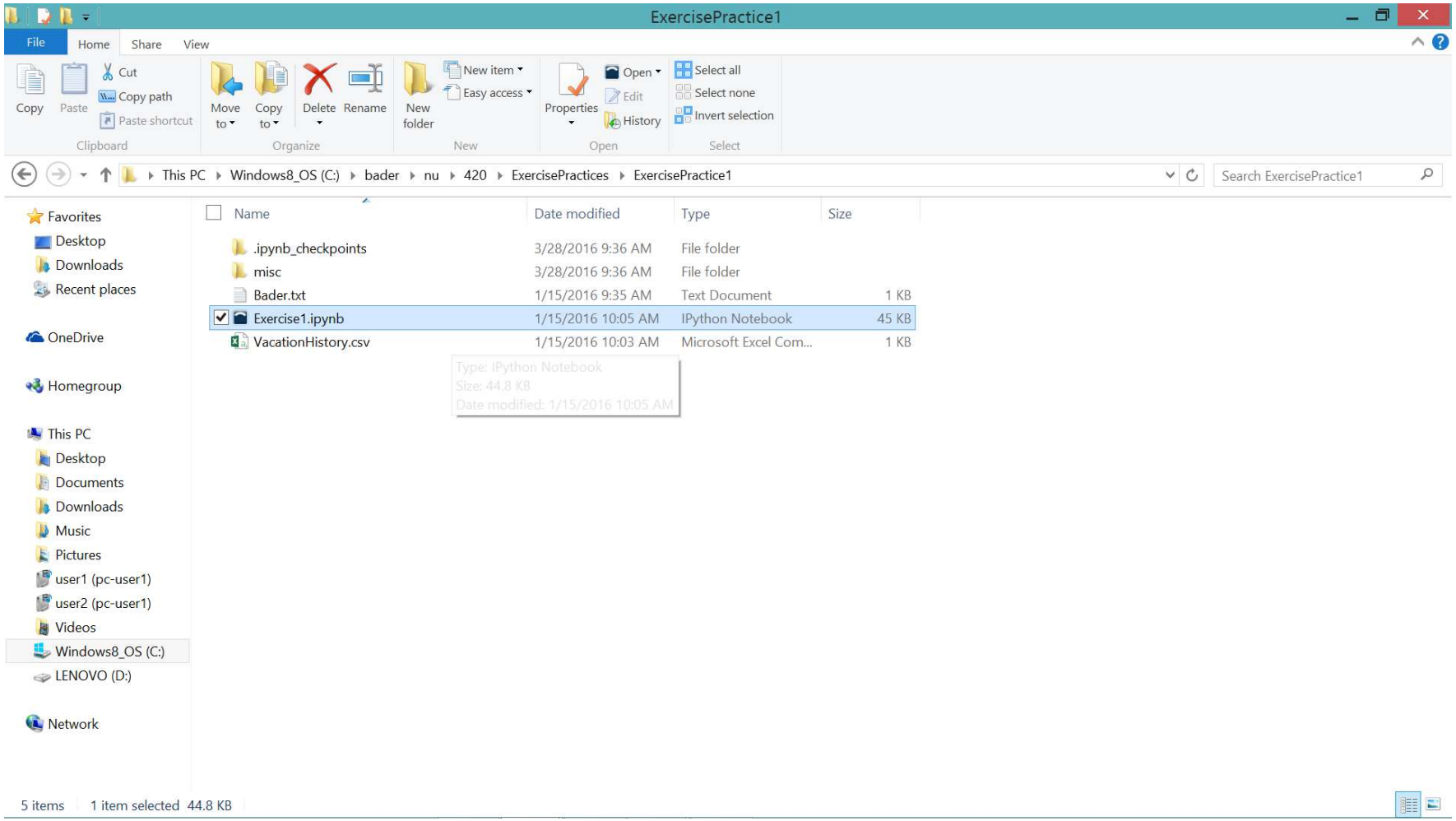
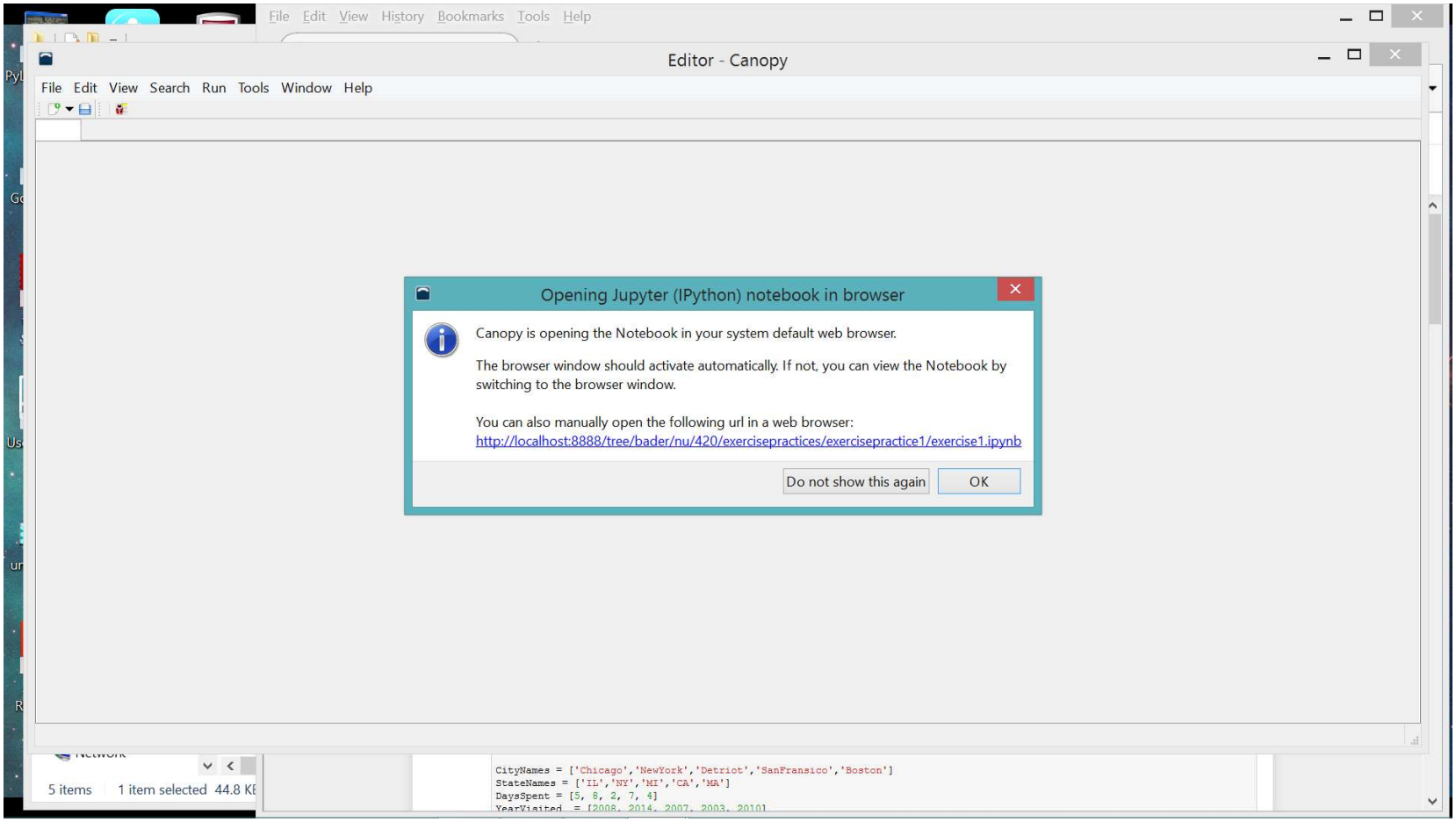
Package Manager
Doc Browser
NOW AVAILABLE
Training on Demand
Recent files
Exercise1.ipynb
Practice1.py
Exercise1.ipynb
Practice1.py
ep1.ipynb
Open an existing file
Restore previous session
Version: 1.5.2.2785
No updates found.

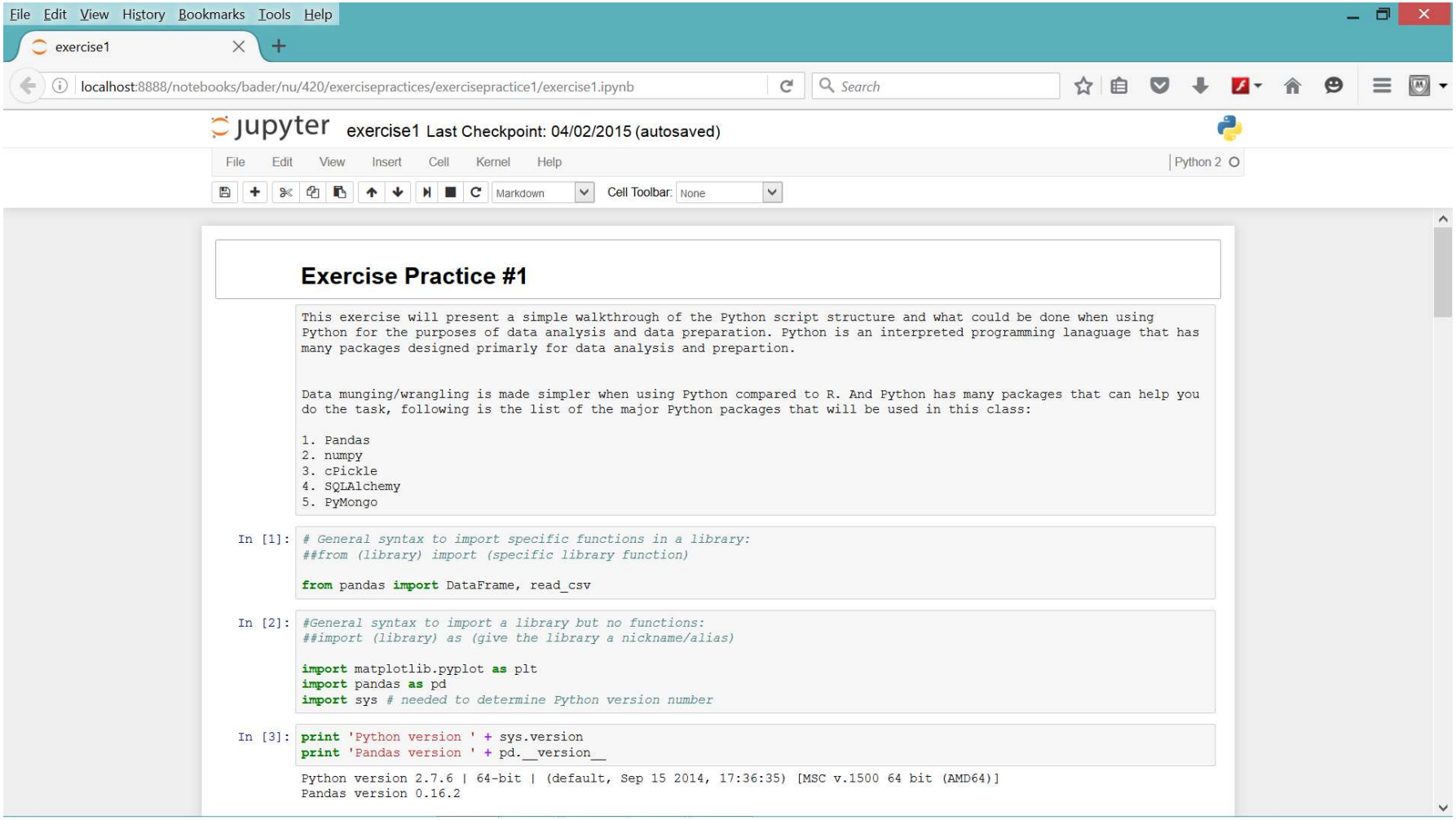
Ipython Notebook



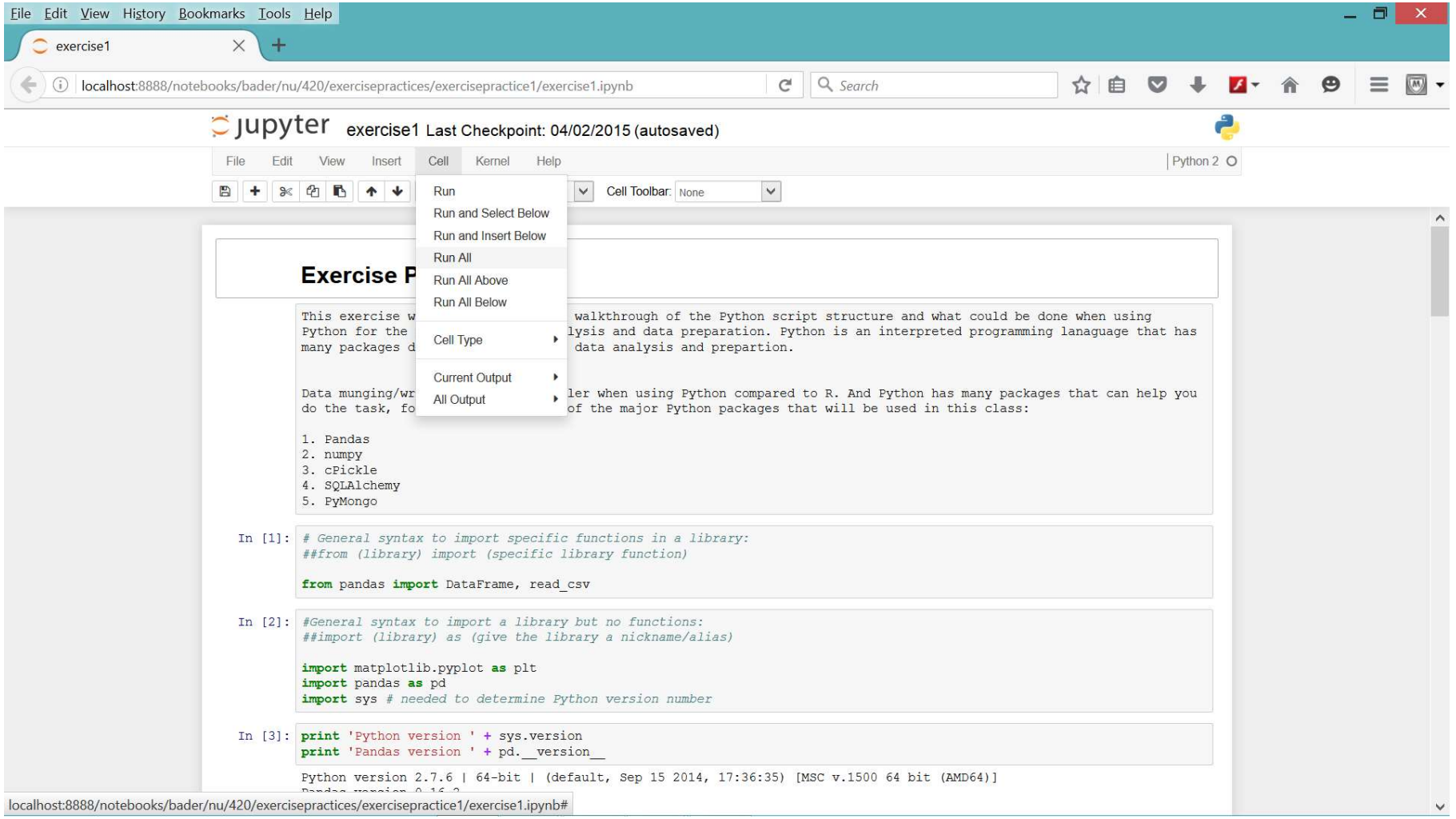
Ipython Notebook



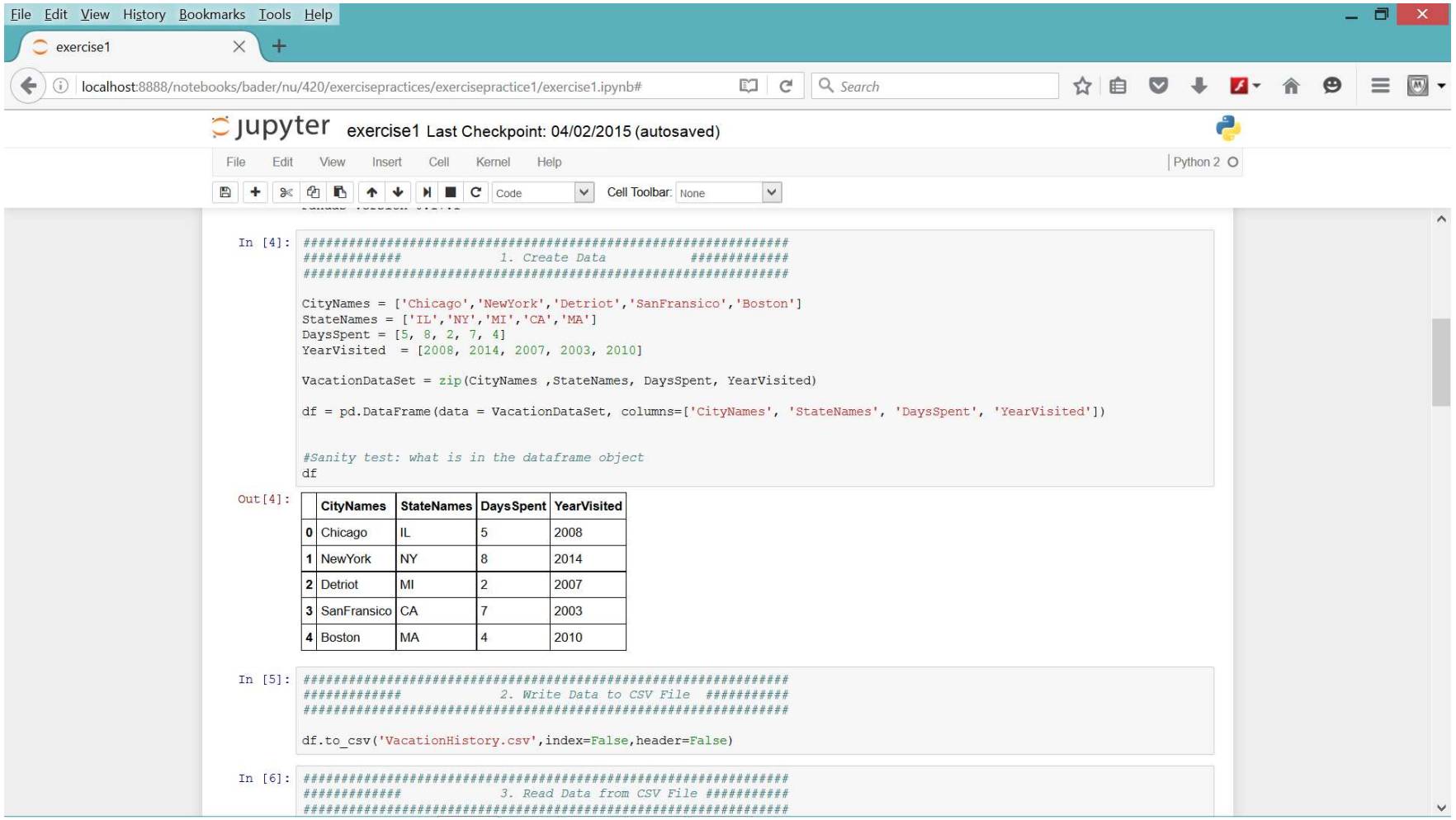
Ipython Notebook



Ipython Notebook

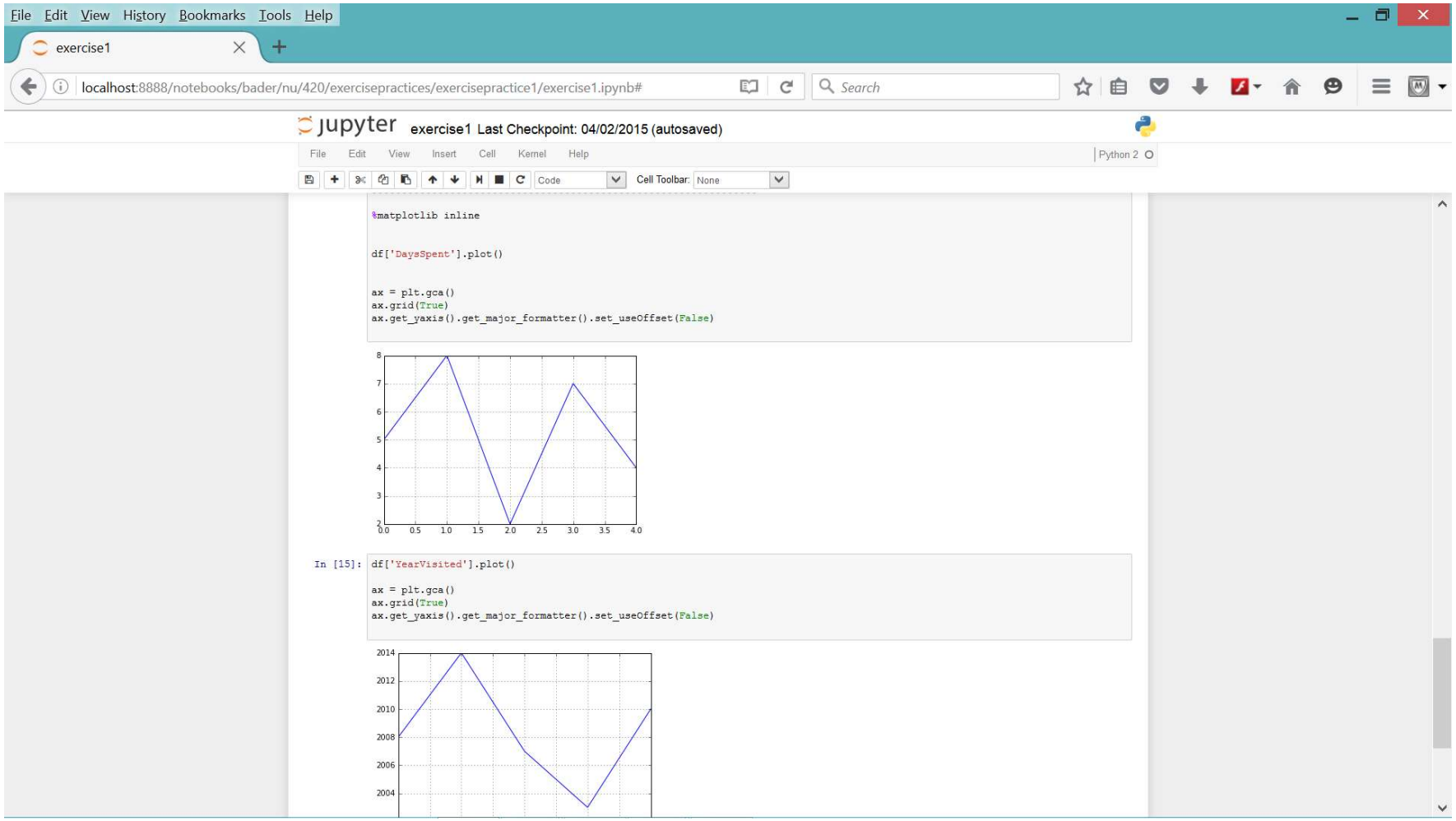


Ipython Notebook



	CityNames	StateNames	DaysSpent	YearVisited
0	Chicago	IL	5	2008
1	NewYork	NY	8	2014
2	Detriot	MI	2	2007
3	SanFransico	CA	7	2003
4	Boston	MA	4	2010

Ipython Notebook



What you need to submit for Exercise #1 on Canvas?

1. Change the data in Exercise #1 to reflect the cities/states/length of the your past 5 vacations
2. Run the IPython Notebook Script Again
3. Save your updated IPython Notebook Script
4. Submit your updated IPython Notebook Script on Canvas

What you need to submit for Exercise #1 on Canvas?

- The following is the only code you need to update