Banks

- Why do banks pay interest to you for your deposit?
- Banks also need to pay for staff, ATM machines, buildings…
- How do banks make money?

Deposits vs Loans

- Banks make money by lending money
- The interest rates for loans are higher than those for deposits

Consumer/Personal Loans

- Loans
  - Automobiles [car loans]
  - Houses [mortgages]
  - Credit cards
  - …
- Which one has the highest interest rate?
- Why?

Commercial/Business Loans

- Expand/start a company
  - Equipment
  - Supplies
  - Buildings
  - Staff
  - …
- …

Credit Cards

- # of US cards in 2008/2009
  - 309 (V) + 211 (MC) + 54 (AE) + 57 (D) = ~631 million
  - Population: ~300 million [infants to …]
Credit Cards

- # of US cards in 2008/2009
  - 309 (V) + 211 (MC) + 54 (AE) + 57 (D) = ~631 million
  - Population: ~300 million [infants to …]

- # of US transactions in 2008
  - 9.2 (V) + 6.3 (MC) + 3.9 (AE) + 1.6 (D) = 21 billion
  - 58M per day
  - 666 per second (average, not peak)

Credit Card Application

Problem 1

How do humans create the knowledge?

- Experience on previous good and bad customers
  - Find characteristics that can differentiate them

But…

How do humans create the knowledge?

- Experience on previous good and bad customers
  - Find characteristics that can differentiate them

- Millions of customers
- Billions of transactions
Credit Card Application

- Decision (approve/deny) in seconds online
- Software
  - Humans create the knowledge for approval
  - Humans implement the knowledge
  - Programs make decisions
- More intelligent software
  - Programs create the knowledge for approval
  - Programs implement the knowledge
  - Programs make decisions

Problem Formulation

- Given (input)
  - Previous customers
    - Fields on the application form
    - Good or bad customer
- Find (output)
  - Knowledge that can differentiate good from bad customers

Problem Formulation

- Given (input)
  - Previous customers -> examples
    - Fields on the application form -> attributes/features
    - Good or bad customer -> class
- Find (output)
  - Knowledge that can differentiate classes

How to represent knowledge?

- One possibility is Decision Tree

<table>
<thead>
<tr>
<th>Income</th>
<th>Class (good)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5K</td>
<td>Y</td>
</tr>
<tr>
<td>5-10K</td>
<td>Y</td>
</tr>
<tr>
<td>10-20K</td>
<td>N</td>
</tr>
<tr>
<td>20-30K</td>
<td>Y</td>
</tr>
<tr>
<td>&gt; 30K</td>
<td>N</td>
</tr>
</tbody>
</table>

Input

<table>
<thead>
<tr>
<th>Attr 1 (income)</th>
<th>Attr 2 (age)</th>
<th>Attr 3 (occupation)</th>
<th>...</th>
<th>Attr m</th>
<th>Class (good)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td></td>
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</tr>
<tr>
<td>N</td>
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<td></td>
</tr>
</tbody>
</table>

Problem Formulation

- Given (input)
  - Previous customers -> examples
    - Fields on the application form -> attributes/features
    - Good or bad customer -> class
- Find (output)
  - Decision tree that can differentiate classes
- Simplification
  - All attributes are discrete, no missing values
Algorithm overview

- Use examples to choose the “best” attribute to be the root node
  - Assign examples to each branch
  - For each branch

Stopping Criteria (reaching the leaves)

1. Running out of attributes
   - Attributes used in the ancestors are not reused

2. Running out of examples
   - Each branch has a subset of the examples
Stopping Criteria (reaching the leaves)

1. Running out of attributes
   - Attributes used in the ancestors are not reused
2. Running out of examples
   - Each branch has a subset of the examples
3. No confusion in the final decision in the examples
   - All examples in the branch belong to the same class

Other Finance Problems

- Business loan application
- Home mortgage application
- Credit card transaction approval (fraud detection)
- Trading (buying/selling) stocks