Machine Learning
  \[\downarrow\]

- Supervised Learning
  \[\downarrow\]

- Basic Models — Decision Trees
  \[\downarrow\]

- linear and non-linear classifiers

**Example: Movie Recommendation System**

<table>
<thead>
<tr>
<th>Explosives</th>
<th>Romance</th>
<th>Subtitles</th>
<th>Animated</th>
<th>Likes?</th>
</tr>
</thead>
<tbody>
<tr>
<td>e1</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>No</td>
</tr>
<tr>
<td>e2</td>
<td>F</td>
<td>T</td>
<td>F</td>
<td>Yes</td>
</tr>
<tr>
<td>e3</td>
<td>F</td>
<td>F</td>
<td>T</td>
<td>No</td>
</tr>
<tr>
<td>e4</td>
<td>T</td>
<td>F</td>
<td>T</td>
<td>No</td>
</tr>
<tr>
<td>e5</td>
<td>T</td>
<td>T</td>
<td>F</td>
<td>Yes</td>
</tr>
<tr>
<td>e6</td>
<td>T</td>
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<td>T</td>
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</tbody>
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- Decision Tree:
  - Binary Tree
  - Internal Nodes are labeled by tests.
  - Arcs are labeled by True/False.
  - Leaves are labeled by output values.

```
if ( Subtitles ) then
  return No
else if ( Romance ) then
  return Yes
else return No.
```

A decision tree can represent any discern function.

- How to generate trees?
- Which trees should be preferred?

**Bias:** Prefer smaller trees over larger trees.
Searching for trees:

Given examples E
if all examples show same output. Y
return Y
else
pick a test to split data
• one that decides evenly
• split gives smallest error.

split examples e⁺ e⁻
repeat recursively on (e⁺)
repeat recursively on (e⁻)

Example:

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Research
- How to split data?
- How to compact Trees.
- How to handle over-fitting
  - pruning tree when examples are small