HW2: An End-to-End Exact PBE

Technical Analysis: Predict price direction using current prices

Patterns: Special forms that signal whether to buy or sell

Goal: Synthesize a program (a model) detecting a pattern


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P0=LLV(Close,W);
BP0=LLVBars(Close,W);
P1=HHV(Close,BP0);
BP1=HHVBars(Close,BP0);
P2=LLV(Close,BP1);
BP2=LLVBars(Close,BP1);
P3=HHV(Close,BP2);
BP3=HHVBars(Close,BP2);
P4=LLV(Close,BP3);
BP4=LLVBars(Close,BP3);
P5=HHV(Close,BP4);
BP5=HHVBars(Close,BP4);
P6=LLV(Close,BP5);
Filter= P0<P1 AND P2<P1 AND P1<P3 AND
P5<P3 AND P4<P5 AND P6<P5;
```

Time-Series Patterns from Charts

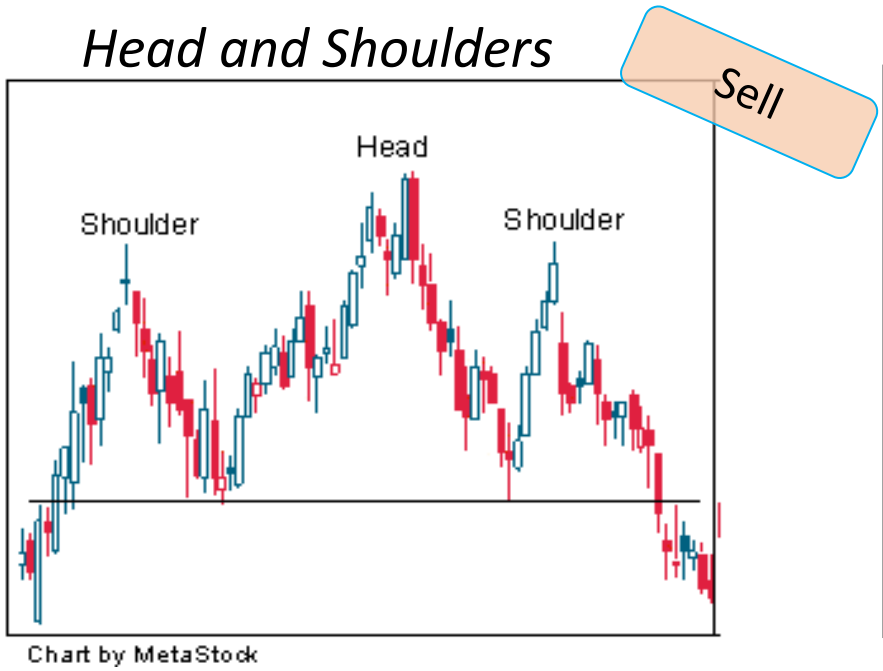
- Goal: an exact PBE that learns patterns in time-series charts
- Time-series charts are used in many domains including financial analysis, medicine, and seismology.

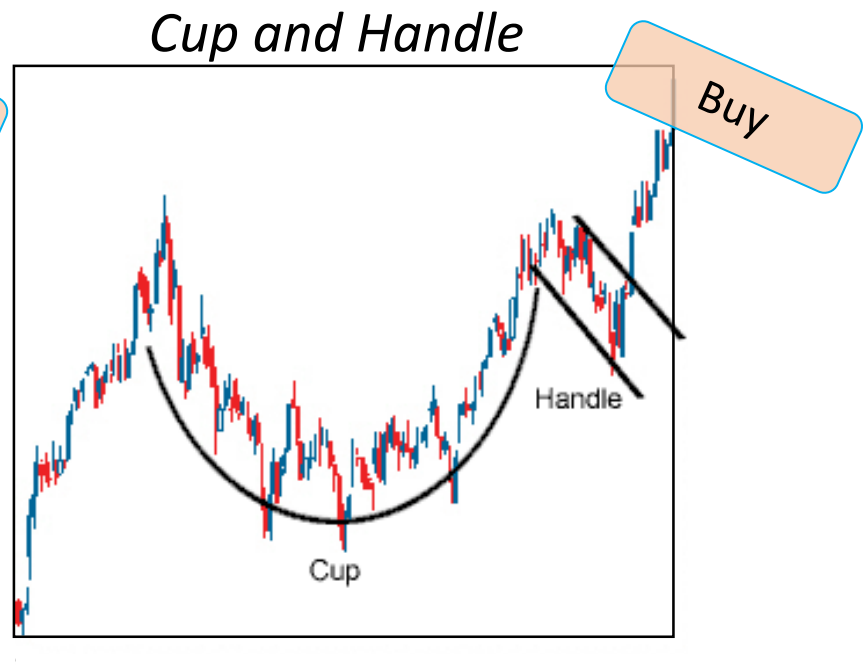
Time-Series Patterns from Charts

- Experts use these charts to predict important events (e.g., trend changes in a stock price) indicated by special patterns

Time-Series Patterns from Charts

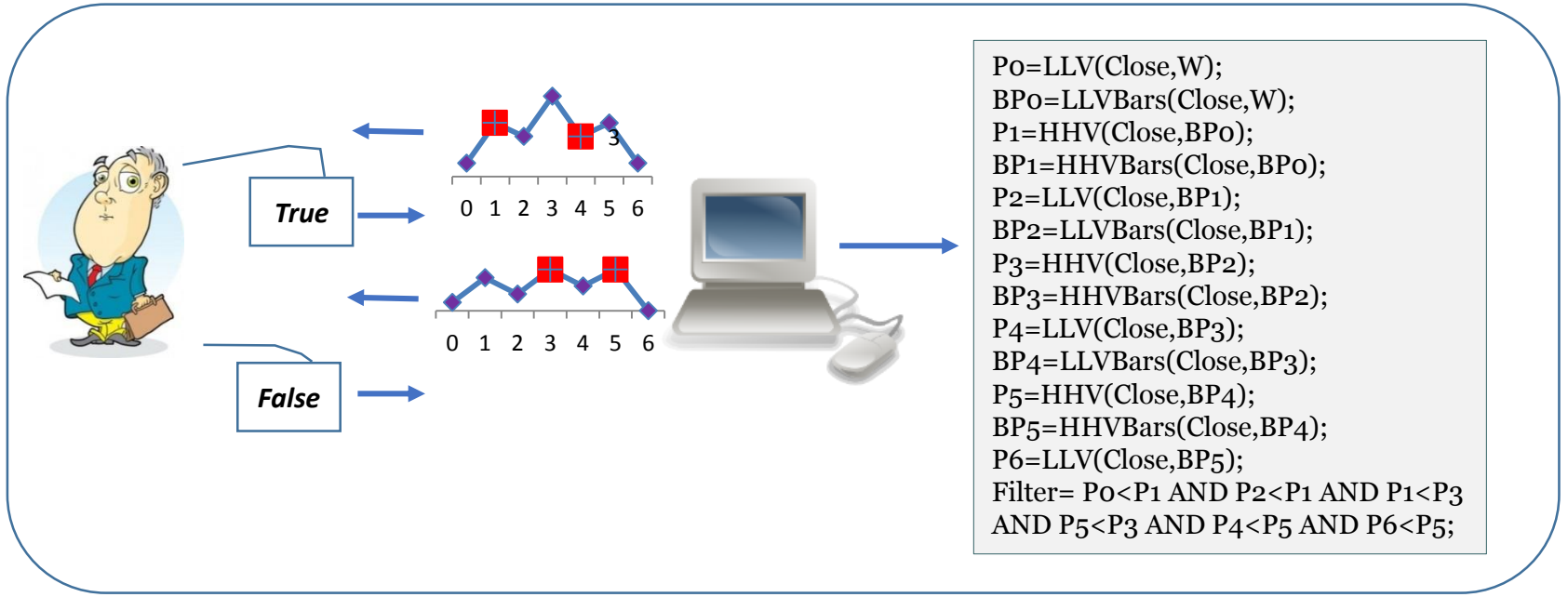
- There is a lot of study on common patterns and there are many softwares that enable these experts to write a program that alerts upon detecting their customized pattern





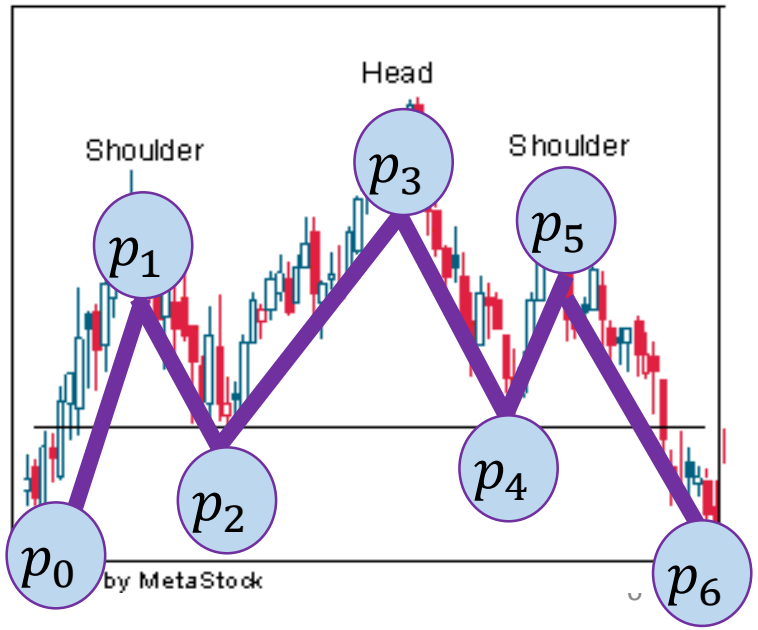
Time-Series Patterns from Charts

- Unfortunately, writing programs is a complex task for these experts, who are not programmers
- Goal: learn the specifications from chart examples, then synthesize a program



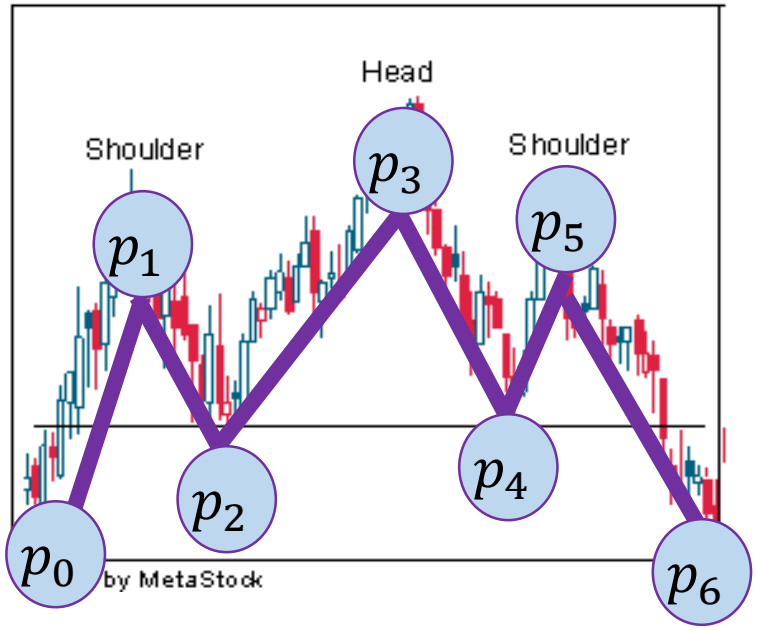
Time-series Patterns

- A chart is a function over time
  - p_i is the price at time point i
- A pattern is a conjunction over $Q = \{p_i < p_j | i \neq j\}$
  - $\varphi_{HS} = (p_0 < p_2) \wedge (p_2 < p_1) \wedge (p_1 < p_3) \wedge (p_2 < p_4) \wedge (p_4 < p_5) \wedge (p_6 < p_5) \wedge (p_5 < p_3) \wedge (p_6 < p_0)$



Exact PBE for Time-series Patterns

- We will assume a slightly different setting
- The learning begins from the user who provides an initial chart example e
- Then, the set of predicates is:
- $Q_e = \{p_i < p_j | e \vDash p_i < p_j\}$
- The conjunctive formula is over Q_n
- Note that $Q_{e,\wedge}$ cannot contain cyclic constraints
  - $p_i < p_j \in Q_{e,\wedge} \Rightarrow p_j < p_i \notin Q_{e,\wedge}$



Questions

1. Define C-SPEX, a variation of D-SPEX for learning conjunctions
   - Hint: What is the search space? How do the lemma change?
2. Let e be a chart example and $Q_e = \{p_i < p_j \mid e \vDash p_i < p_j\}$
   a) Define how to compute the children of a node. What is the time complexity?
      - Hint: represent the constraints in a graph whose nodes are p_i
   b) Define how to find the witnesses. What is the time complexity?
      - Hint: topological sorting
   c) Determine how many membership queries C-SPEX can present.
      - Hint: the bound is much better…