**Algorithm 1** AI-Quant-Factor-Mining-Pipeline($\mathcal{T}, \mathcal{D}_{stock}, \mathcal{D}_{index}$)

**Input:** Task List $\mathcal{T}$, Stock Data $\mathcal{D}_{stock}$, Index Data $\mathcal{D}_{index}$
**Output:** Factor Library (Code files $\mathcal{F}_{code}$ & Data files $\mathcal{F}_{data}$)

**Initialize** LLM Provider $\mathcal{M}$ (DeepSeek or Gemini) with API Key
**Initialize** Output Paths $P_{code}, P_{data}$
**for each** seed task $s$ in $\mathcal{T}$ **do**
  // **Phase 1: Phase 1: Ideation (Brainstorming)**
  $\mathcal{V} \leftarrow \mathcal{M}$.Ideate($s$.idea, $s$.num, Schema)
  // **Phase 2: Code Generation**
  **for each** variation $v$ in $\mathcal{V}$ **do**
    $name \leftarrow v$.factor_name ▷ Enforce CamelCase
    $desc \leftarrow v$.factor_description
    $C \leftarrow \mathcal{M}$.GenCode($desc, name$, Constraints)
  // **Phase 3: Execution & Validation**
    $Func \leftarrow$ SaveAndLoadModule($C, name, P_{code}$)
    **if** $Func \neq$ null **then**
      $R \leftarrow Func(\mathcal{D}_{stock}, \mathcal{D}_{index})$ ▷ Execute in Sandbox
      **if** ValidateColumns($R$, ['SecuCode', 'TradingDay', $name$]) **then**
        $R$.SecuCode $\leftarrow$ Substring($R$.SecuCode, 0, 6) ▷ Format Fix
        SaveToParquet($R, P_{data}$)
      **else**
        **Log Error** "Validation Failed: Column Mismatch"
      **end if**
    **end if**
  **end for**
**end for**