LLM-based Agents for Social Simulation

Individual LLM Agent

- **Profile Module**
  - Static Demographic Information Configuration — Handcraft Configuration [22] Program Generation [29] LLM Generation [26] Real Dataset Generation [94] Combined [32]
  - Dynamic Social Attributes Update — Action Driven [86], [98] Human Driven [100] Environment Driven [35] Action-Environment Driven [27]
- **Perception Module**
  - Social Context Demensions — Physical Environment [22], [35] Other Agents' States [101], [102] Social Norms [38], [100]
  - Technical Approaches — Text-Only [22], [99] Multi-modal [103], [104] Social Cognition Theory [102], [105]
- **Memory Module**
  - Knowledge-Base Based Memory — Storage [106], [107] Retrieve [26], [27] Write [85], [102], [108] Forget [32], [111], [111] Reflect [22], [99]
  - Model Parameters Based Memory — Supervised Fine Tuning [116], [117] Parameter Efficient Fine Tuning [119], [120] Reinforcement Learning from Human Feedback [90], [100]
- **Planning Module**
  - Plan Generation — Goal Oriented [103] Time Based [86], [107], [123] Event Driven [106]
  - Plan Decomposition — Divide & Conquer [85], [86], [125]–[127]
  - Plan Updating — Reactive Adjustment [106] Progress Monitoring and Failure Handling [86]
  - Multi-agent Planning — Collaborative [100] Competitive [115], [128] Cooperation [129]
- **Action Module**
  - Action Types — Predefined [106], [108], [115] Free-form [22], [103] Hybrid [26], [98]
  - Action Mechanisms — Profile-base [90], [132]–[134] Memory-based [25], [102] Plan-based [103], [140] Multiple [22], [100]

Multi-agent System

- **Environment**
  - Feedback Mechanisms — Unicast [131] Multicast [108] Broadcast [141] Prioritize & Filter [26], [32]
  - Dynamic Evolution — Agent Driven [108] Stochastic [26] Rule Based [35]
  - Social Constraints — Explicit Constraints [135], [142] Implicit Constraints [67], [143], [144]
- **Multi-agents Management**
  - Agent Configuration — Empty Initialization [26] Profile Based [26] Historical Data Based [108] Cognitive Parameter [140]
  - Agent Scheduling — Sequential [26] Parallel [108] LLM Manager [30]
  - Agent Monitoring — Boundary Enforcement [30] Intervention [135] Adaptation [38]

Evaluation

- **Micro Evaluation**
  - Action Criteria Approach — Rationality [26], [32], [38], [135] Consistency [22], [67] Accuracy [28], [35], [131]
  - Module Specific Approach — Memory [103], [142], [146] Planning [22], [98], [103] Action [38], [67]
- **Macro Evaluation**
  - Believability [27], [28], [30], [107], [147]
  - Scalability [22], [32], [94]
  - Efficiency [30], [130], [148]
  - Cost [26], [85], [130]
- **Evaluation Methods**
  - Subjective — Human Based [22], [67] LLM Based [26], [32], [38]
  - Objective — Regression Eq.4 Eq.5 Classification [149] Text Similarity [150], [151]

Application

- **Discovering Social Patterns** — Emergence of scale-free networks in social media [152] Propagation dynamics of social norms in the workplace [154]
- **Interpreting Social Phenomena** — Behavioral responses to illness and case surges [155] Trust formation through inter-firm communication [115] Reduction of information friction via contracts [156]
- **Validating Social Theories** — Collective decision-making under electoral dynamics [157] Role of Theory-of-Mind in cooperation [158] Validation of small-world theory in social networks [108]
- **Forecasting Policy Outcomes** — Impacts of public housing allocation policies [141] Information diffusion under content moderation [30] Effects of taxation on economic inequality [35] Impact of policy interventions on prosocial behaviors [95]

Fig. 2. Taxonomy of LLM-based Agents for Social Simulation.