DARPA project

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DARPA CREATE project introduction

- **DARPA** stands for Defense Advanced Research Projects Agency
- **CREATE** is Context Reasoning for Autonomous Teaming
- **CREATE** seeks to develop the theoretical foundations of autonomous AI teaming to enable a system of heterogeneous, contextually-aware agents to act in a decentralized manner and satisfy multiple, simultaneous and unplanned missions goals.
- Our proposal: **Decentralized Optimized Context-aware Teaming**
- **Team lead: Ankur Mehta**
- **Team member:**
  - **Daniel Selva(TAMU), Yizhou Sun(UCLA), Hadas Kress-Gazit(Cornell)**

Proposal Summary

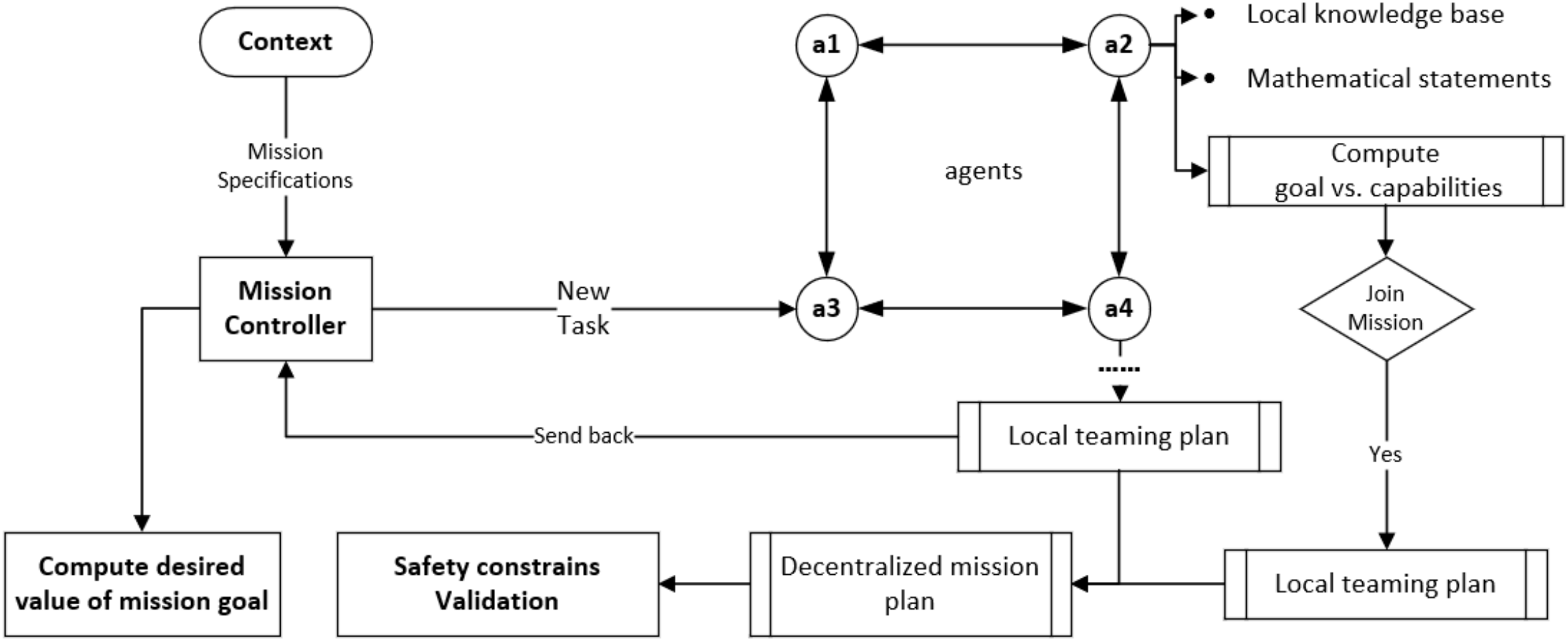
- **Mosaic systems:** networked, heterogeneous, time-varing collections of **agents.**
- These agents have their original deployment and applications.
- The general resource in these agents can be leveraged for new missions, which required individual expert design.
- We proposed **unclassified fundamental research** to develop a system whereby agents independently choose whether and how to respond to a new mission through **context-awareness**.

Goals

- Agents in our system can dynamically respond to new and unexpected mission.

- To apply context to imbue agents with “machine understanding ” as they relate to incoming task requests.

Functionality



Challenge problems

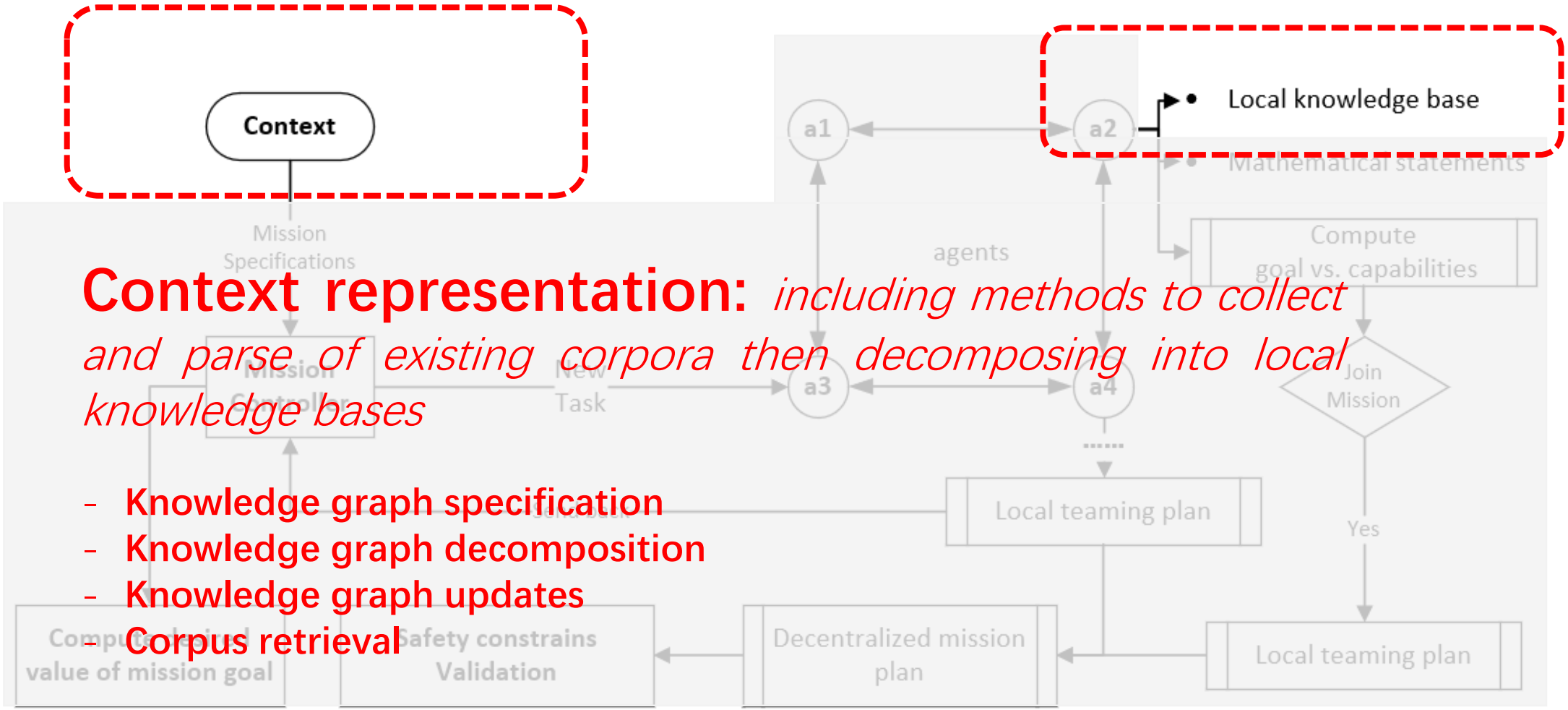
(1) To detect single instance of a rocket launch

- To detect helicopter take-off
- To detect earthquake

(2) To continuously track a specified vehicle

- To track a specified people
- To allocate traffic resource if a car accidence happens

Technical plan: Context representation

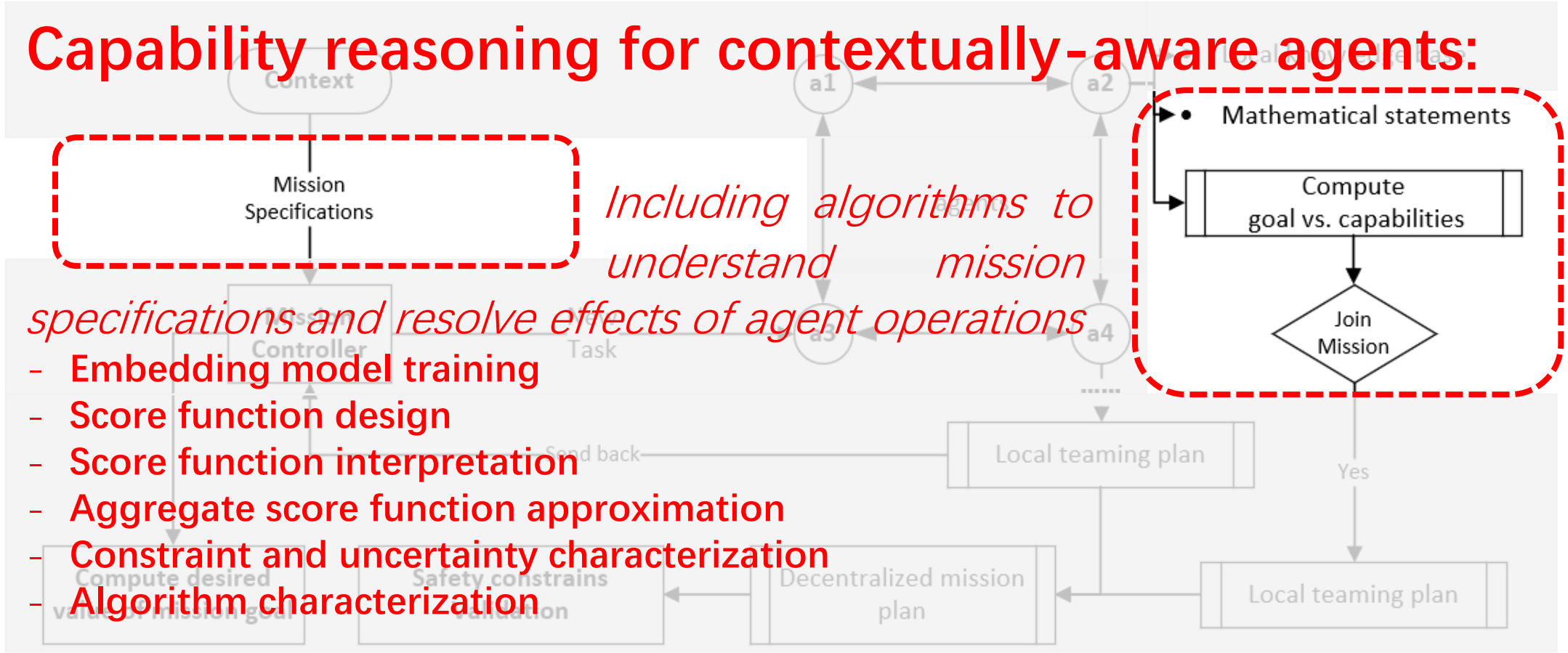


Context representation: *including methods to collect and parse of existing corpora then decomposing into local knowledge bases*

- **Knowledge graph specification**
- **Knowledge graph decomposition**
- **Knowledge graph updates**
- **Corpus retrieval**

Technical plan:
Capability reasoning for contextually-aware agents

Capability reasoning for contextually-aware agents:



Including algorithms to understand mission specifications and resolve effects of agent operations

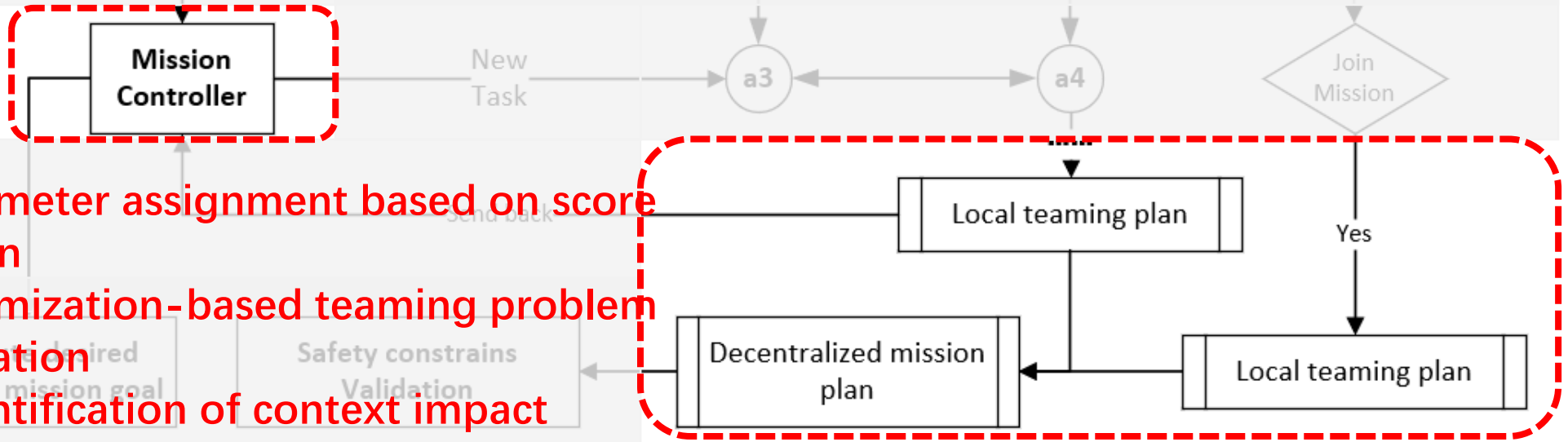
- **Embedding model training**
- **Score function design**
- **Score function interpretation**
- **Aggregate score function approximation**
- **Constraint and uncertainty characterization**
- **Algorithm characterization**

Technical plan:
Local planning for decentralized decision making

Local planning for decentralized decision making:

including design problem optimization formulation, decentralized approximations, and performance evaluation

- **Decentralized formulation of teaming algorithm**
- **Oracel-based context enhancements**

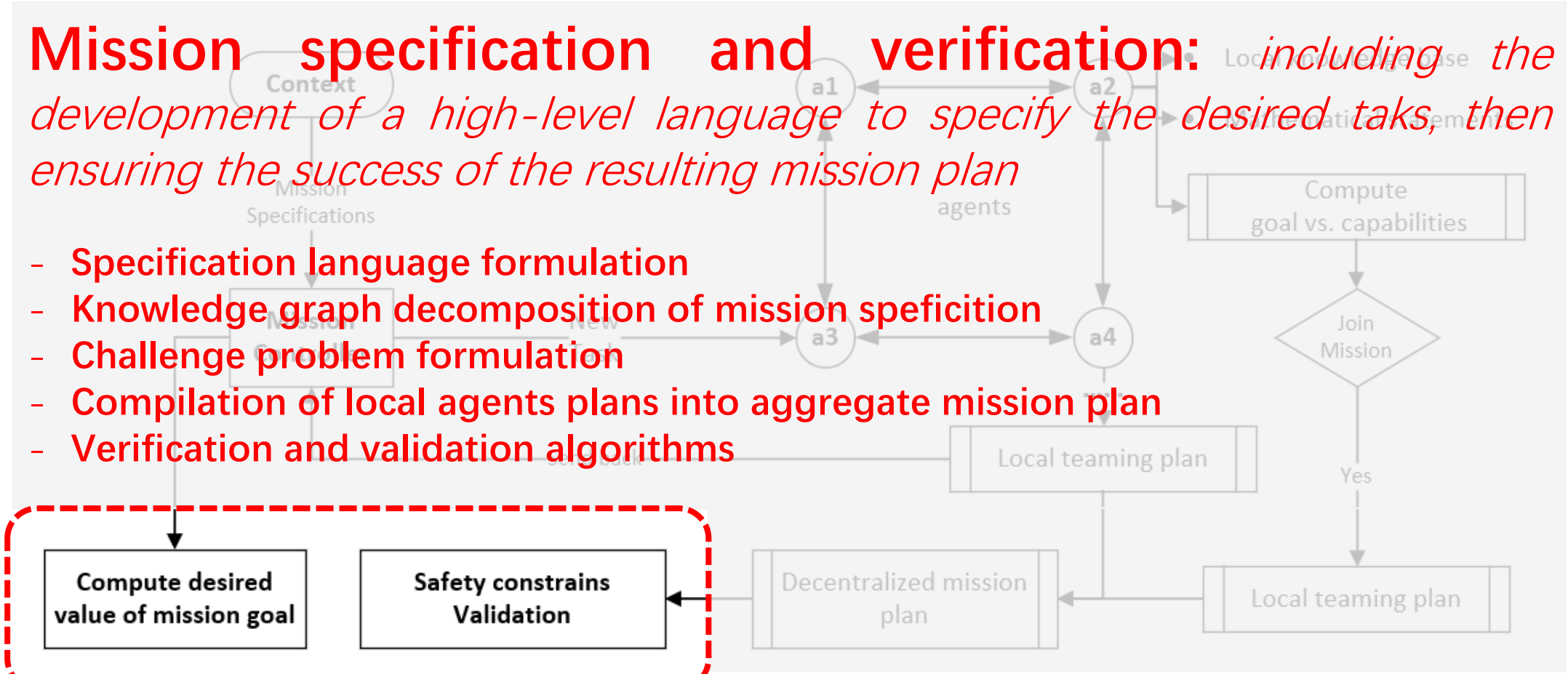


- **Parameter assignment based on score function**
- **Optimization-based teaming problem formulation**
- **Quantification of context impact**

Technical plan:
Mission specification and verification

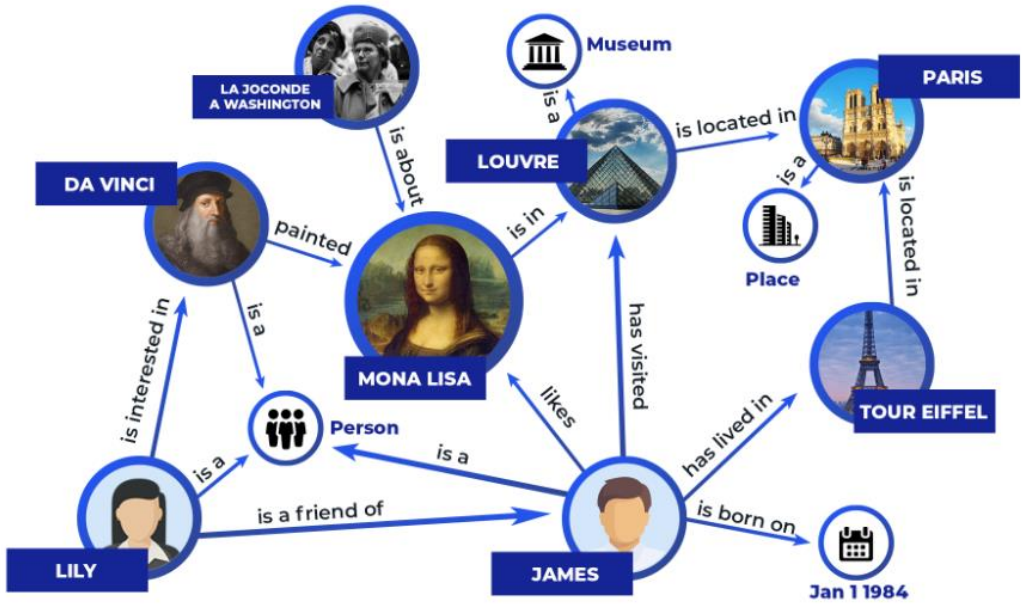
Mission specification and verification: *including the development of a high-level language to specify the desired taks, then ensuring the success of the resulting mission plan*

- Specification language formulation
- Knowledge graph decomposition of mission speficition
- Challenge problem formulation
- Compilation of local agents plans into aggregate mission plan
- Verification and validation algorithms



Knowledge Graph

- A Knowledge Graph is a model of a knowledge domain created with the help of intelligent machine learning algorithms. It provides a structure and common interface for all of your data and enables the creation of smart multilateral relations throughout your databases.
- Entities
  - E.g., Da Vinci, Mona Lisa
- Relations
  - E.g., painted
- Triples
  - E.g., (Da Vinci, painted, Mona Lisa)



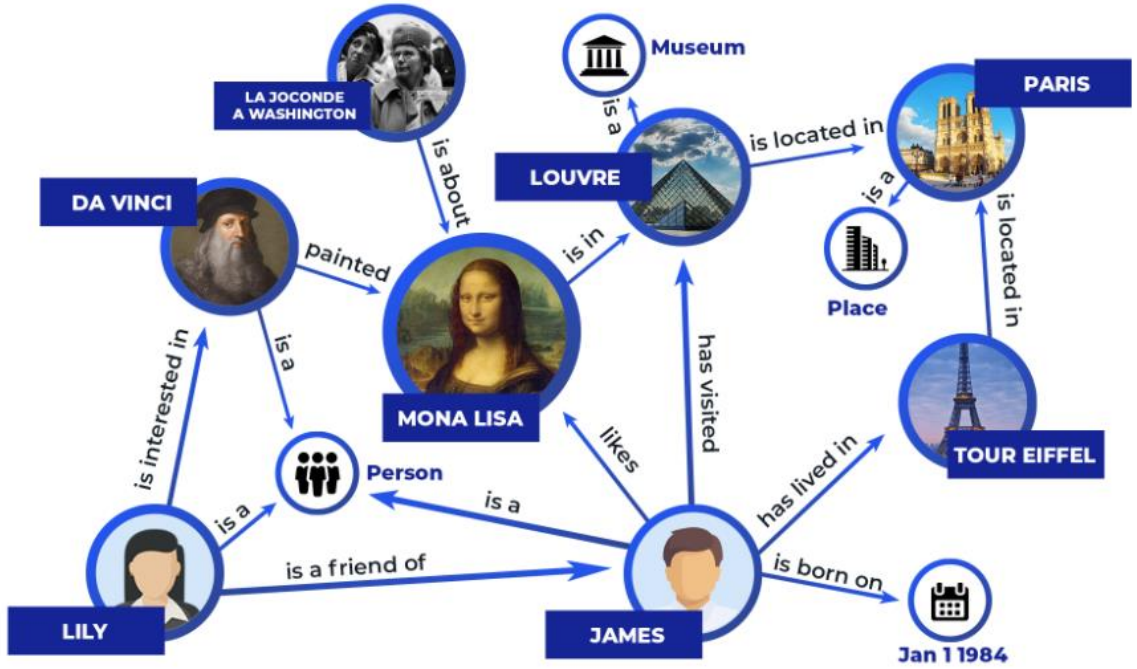
- A knowledge graph is a collection of triples

Why Knowledge Graph

- **1. Combine Disparate Data Silos**

- **2. Bring Together Structured and Unstructured Data**

3. Make Better Decisions by Finding Things Faster



Knowledge Graph

- We can only collect small amount of knowledge

- How to infer missing knowledge based on the observed triples?

- **Knowledge graph Embedding**