

---

# Gaining Battlefield Awareness Through Entity Clustering and Classification

Weixiong (Wayne) Zhang, Randy Hill and Jonathan Gratch

Information Sciences Institute  
University of Southern California

May, 1999

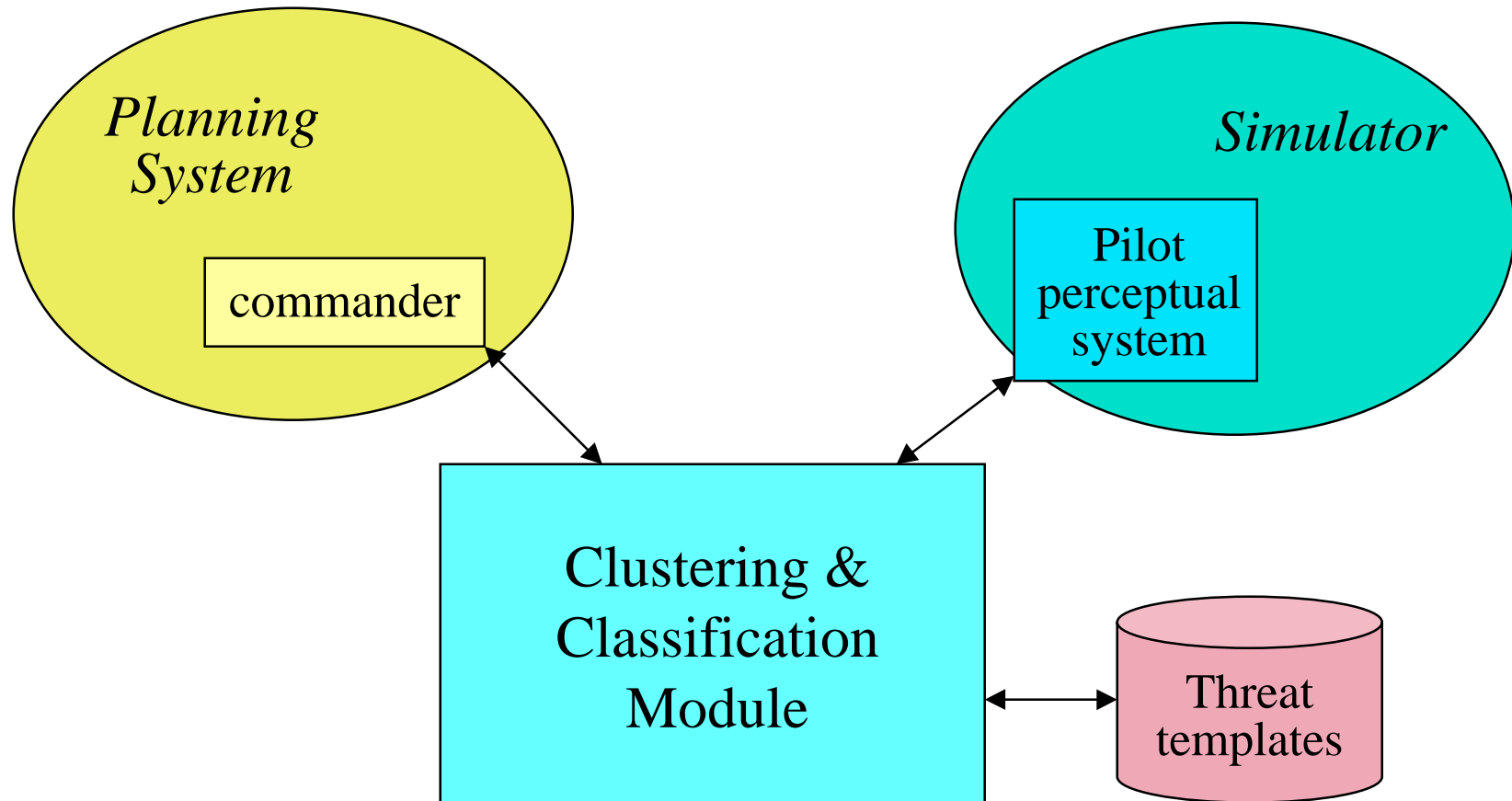
# The Problem

---

- ◆ Situation awareness is the foundation for
  - Determining achievable goals and missions
  - Selecting strategies
  - Selecting actions
  - Planning
- ◆ Assessment of synthetic battlespace involves
  - Identifying different entities
    - » vehicles, airplane, artillery batteries, etc.
  - Classifying and clustering entities into units
    - » units can be hierarchical - low level units form a high level unit.
  - Determining units' functionality and capabilities

# Gaining Battlefield Awareness

---



# Clustering and Classification

---

- ◆ Bottom-up and top-down combined approach
- ◆ Bottom-up clustering based on geographical information
  - Identify a group of entities close to each other.
  - Other useful features: color, orientation, speed.
- ◆ Top-down classification based on doctrines
  - Threat templates
  - Issues: which template, partial matching.

# Bottom-Up Clustering Based on Geographical Information

---

- ◆ Hierarchical Clustering
  - Partitioning starting at the top until a satisfactory level (e.g. individual units)
- ◆ Robust Clustering
  - Nearest-neighbor using center of mass
    - » works well for hierarchical clustering
    - » requires a parameter of minimal distance
  - Density-based clustering
    - » works well on different shapes of patterns
    - » no parameter is required (or can be learned)

# Top-Down Classification Based on Threat Templates

---

- ◆ Classification and prediction
  - Classification based on threat templates
    - » Doctrine of situations, actions, formation and capacities
    - » matching clustered units with templates for classification
  - Partial matching to predict the location of missing units
- ◆ Encoding threat templates
  - Encoding spatial information for symbolic processing
    - » Kd-tree to encode spatial relationships
  - Adding possible actions to nodes (units)

# Spatial information in kd-tree (an example)

---

