**Problem:** Repetitive Combinatorial Optimization Problems (R-COP)

**Approach:** GDGP-Twin – a hybrid ML pipeline for distributed control in networks

1. **Independent R-COP**
   - Optimize each instance individually
   - Goal: reduce optimality gap with minimal overhead

2. **R-COP in graph-based MDP**
   - Inter-state dependency MUST be considered
   - Goal: achieve long-term system-wide objective

**Key features**
- All distributable components (Actor, Critic, Heuristic)
- Pipeline can generalize to different network topologies
- Constraints guaranteed by the heuristic
- Future returns encoded in cost vector input to heuristic

**Key novelty**
- Defines vectorized (element-wise) reward and return for network settings
- Critic based on a twin network that predicts element-wise expected returns/outcomes

**Test Results**

- **Independent R-COP**
  - Maximum Weighted Independent Set
  - Approximation ratio
  - Execution local complexity
  - Training complexity

- **R-COP in graph-based MDP:** Delay-oriented link scheduling
  - Test based on four different R-COPs
  - Approximation ratio
  - Execution local complexity
  - Training complexity

**Conclusion**

1. A general actor-critic framework
2. Applicable to R-COPs with limited runtime and distributed execution
3. Reduce optimality gap with minimal overhead
4. Enable long-term goal seeking
5. Beyond COP: applicable to general network processes

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**References:**