Approximation Modeling for the Online Performance Management of Distributed Computing Systems

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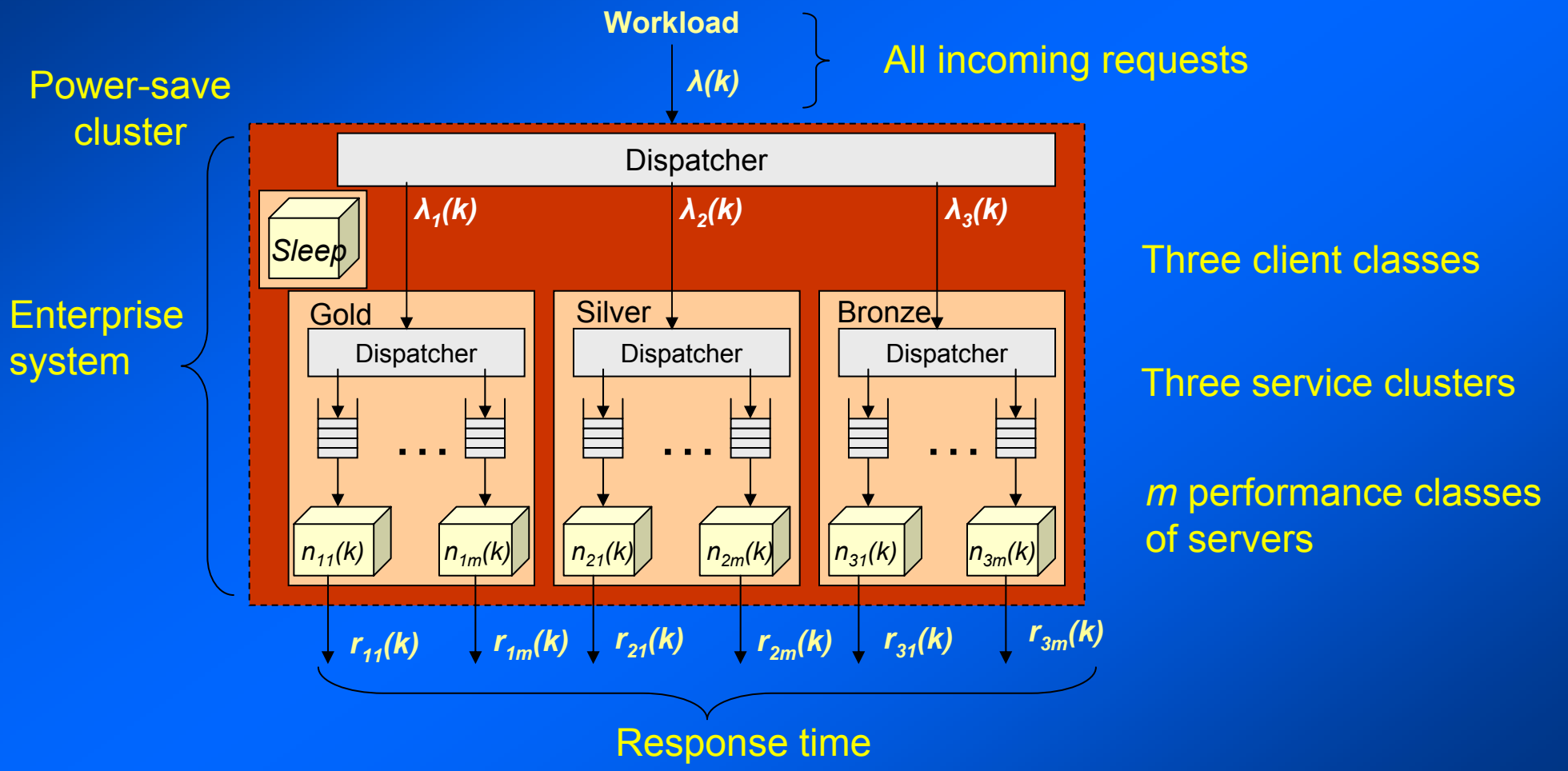
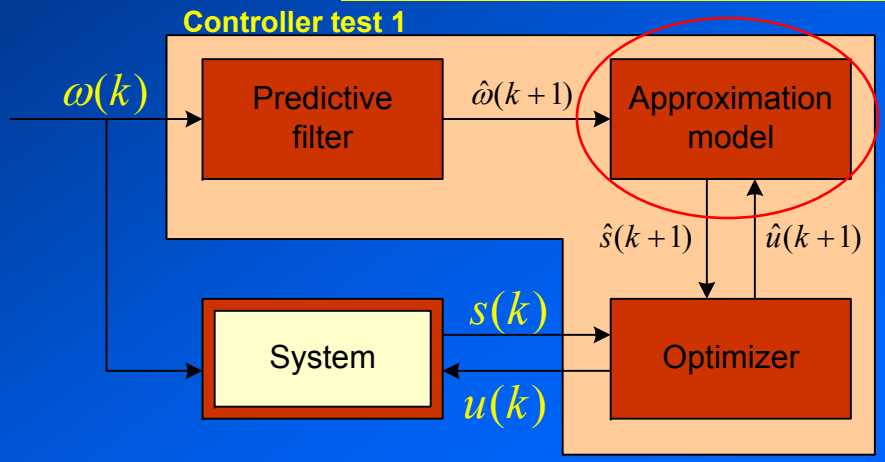
SYSTEM MODEL



CONTROL PROBLEM

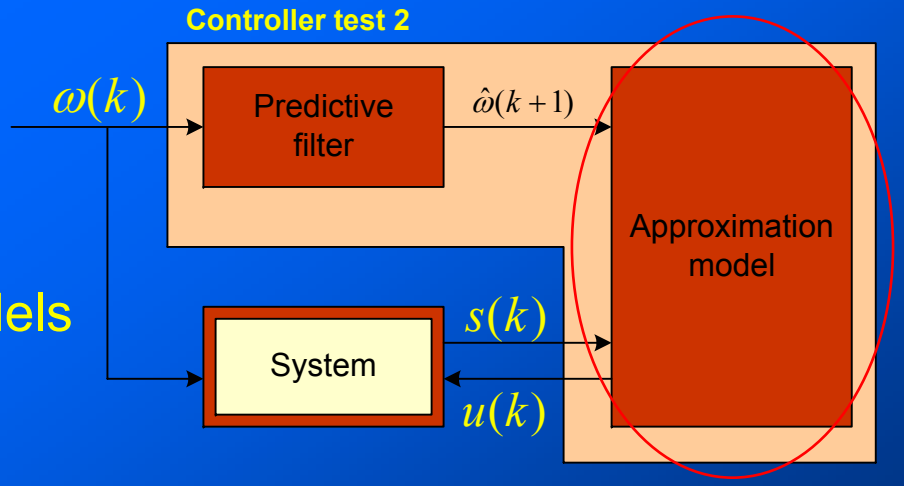
- Maximize profits over all services
  - Workload generated by the various client classes is time varying
- Solve the optimization problem in real time
  - Tackle the "curse of modeling"
    - The system is characterized by complex nonlinear behavior
  - Tackle the "curse of dimensionality"
    - The state space is large to search for each control input
- Use limited lookahead control (LLC) approach

CONTROLLER DESIGN

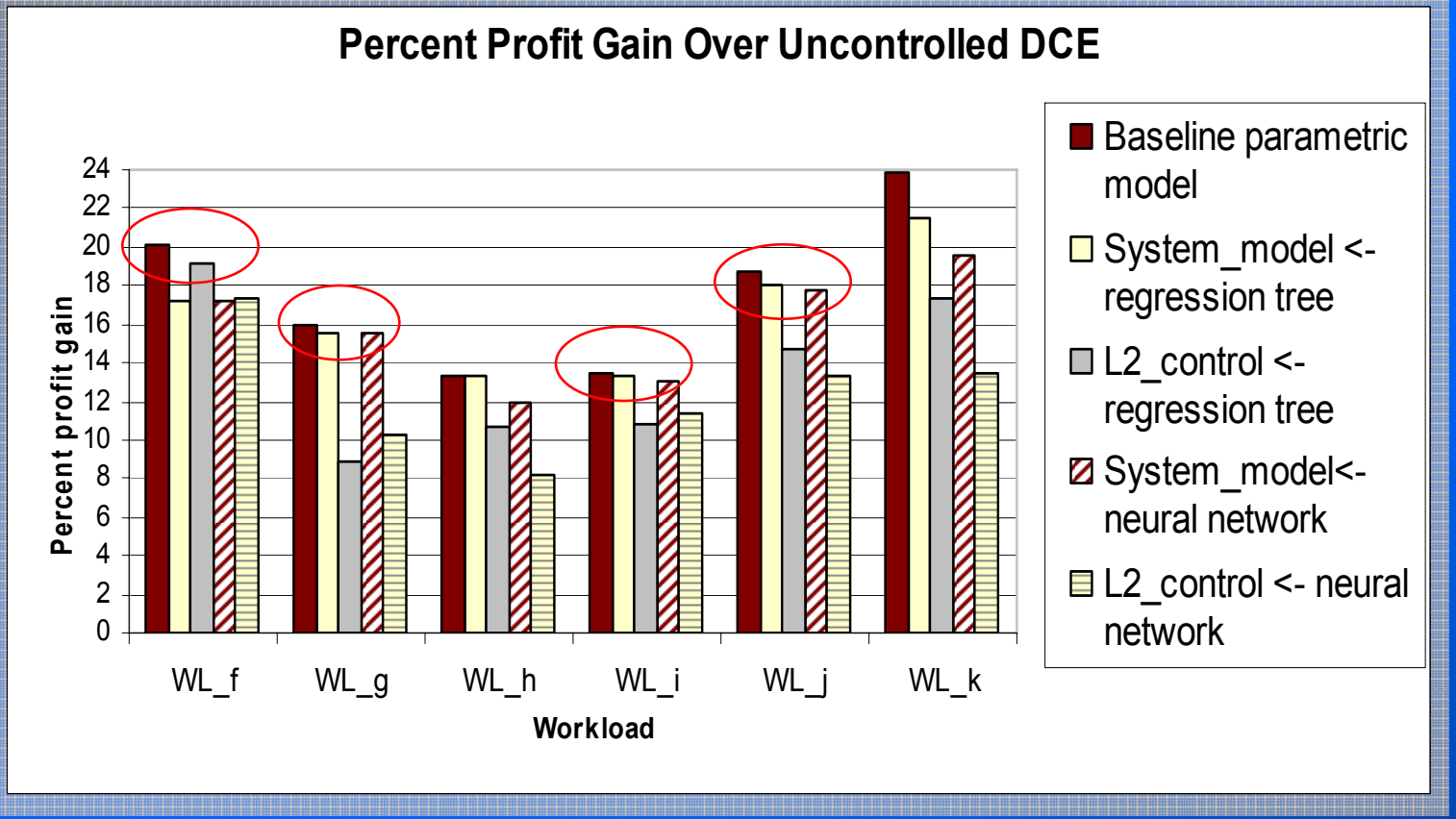


- Train approximation models via simulation-based learning and test the performance against controllers with explicit equations for the system behavior and optimization process

- Approximate the system behavior
  - Tackle the "curse of modeling'
- Approximate the controller behavior
  - Tackle the "curse of dimensionality"
- Validate two types of approximation models
  - Neural network
  - Regression tree



EXPERIMENTAL RESULTS



- Best results using approximation modeling are within 1% of control with explicit equations
- Control overhead is reduced by 12%-98% when using approximation models

CONCLUSIONS

- Profit gains in the best case are within 1% of that earned by a controller having perfect knowledge of the system
- Approximating the system behavior results in a 12-78% reduction in overhead
- Approximating the control behavior results in a 98% reduction in overhead

Full results published in a technical report:

D. Kusic, N. Kandasamy and G. Jiang, "Approximation Modeling for the Online Performance Management of Distributed Computing Systems," Drexel University, *Technical Report*, February 2007.