X Jornadas de Paralelismo - La Manga del Mar Menor (Murcia)

Tools for Extensibility in Parallel Execution Environments

Albert Serra, Xavier Martorell, Ernest Artiaga,
Yolanda Becerra, Marisa Gil, Nacho Navarro

Departament d'Arquitectura de Computadors
Universitat Politècnica de Catalunya

Outline

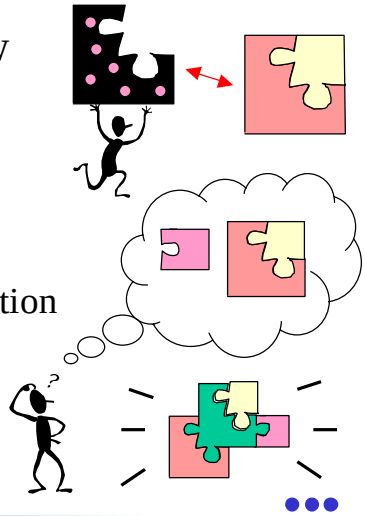
- **Motivation**
- Approach
- DITools
  - Interposition
- Examples
  - Monitoring
  - Transformation
  - Incremental improvement
  - Rapid prototyping

Motivation

- HPC issues:
  - Be able to analyze the efficiency of computations
  - Be able to tune critical components
- Some difficulties:
  - Vendor-specific environments
  - Proprietary support (e.g. numerical libraries)
  - Generic OS resource management policies
  - Source code is not always available

Approach

- From the OS point of view
- Give support to
  - Dynamic replacement of critical components
  - Incremental program evolution
  - Flexible composition

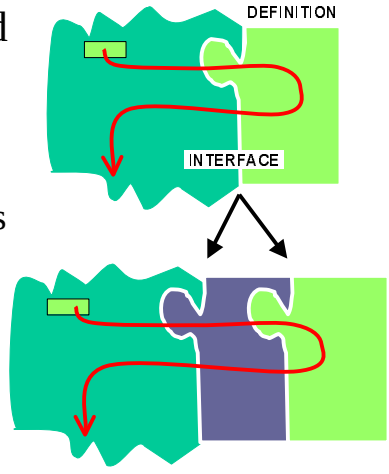


DITools

- DITools: Tools for extensibility
  - Loading and linking of modules
  - Control over reference resolution
  - Control over definitions of services
  - Interposition facilities
  - Event-like notifications
- These tools allow flexible composition

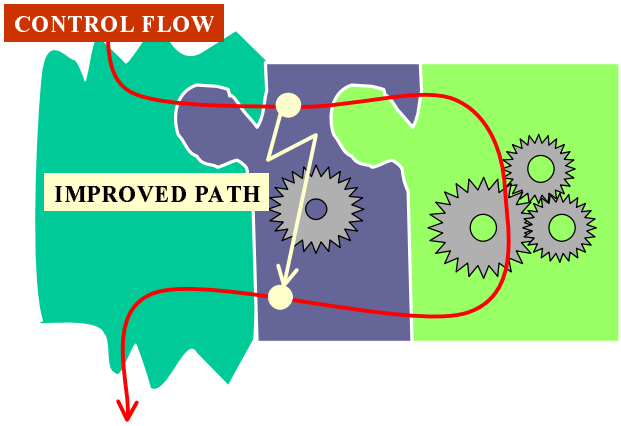
Interposition

- Extensions are introduced at interface boundaries:
  - Preserves interfaces
  - Keeps previous definitions
  - Transparent
  - “Stackable”



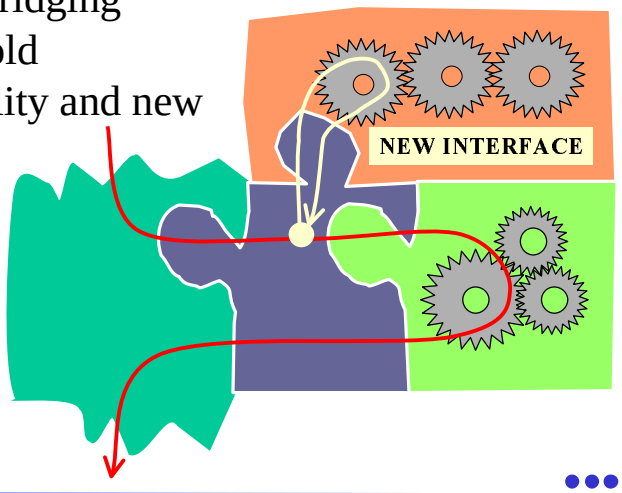
Interposition: Applications (1)

- Allows incremental improvements

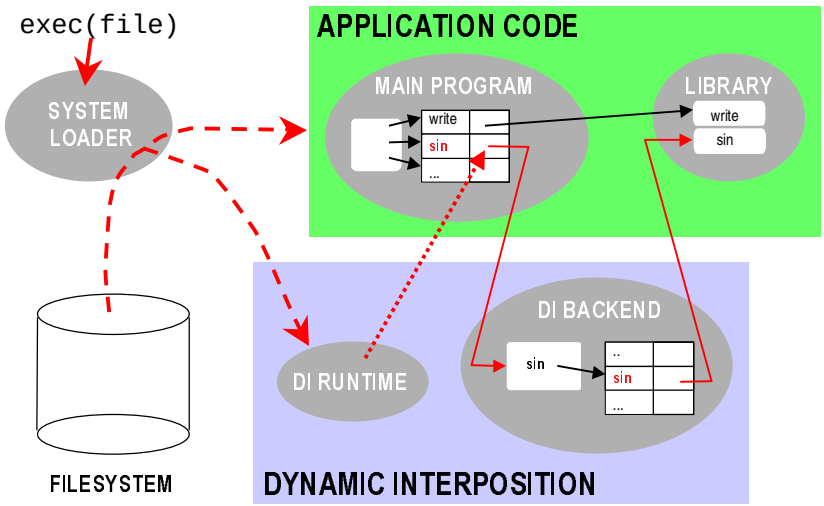


Interposition: Applications (2)

- Enables bridging between old functionality and new interfaces

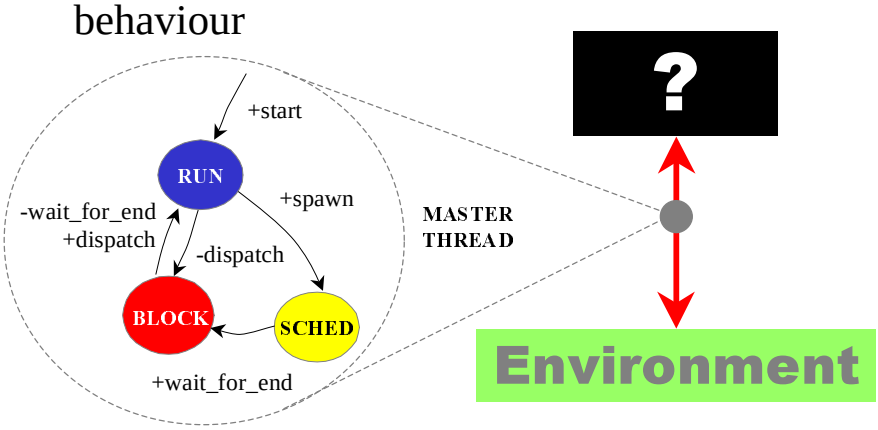


How it works



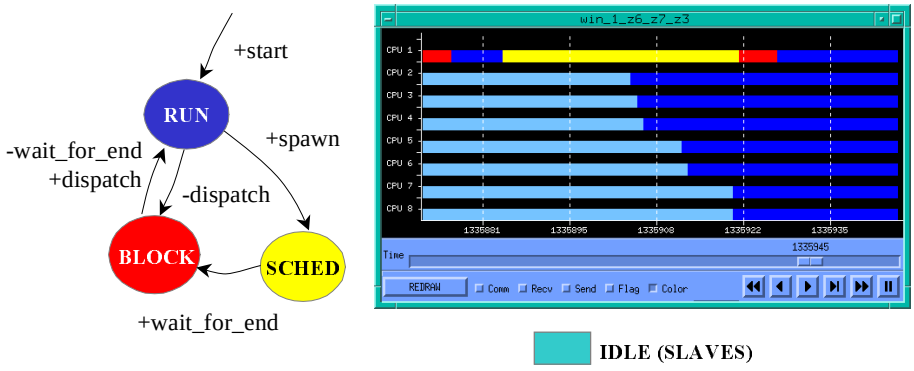
Example: Monitoring (1)

- Capture interactions to analyze program behaviour



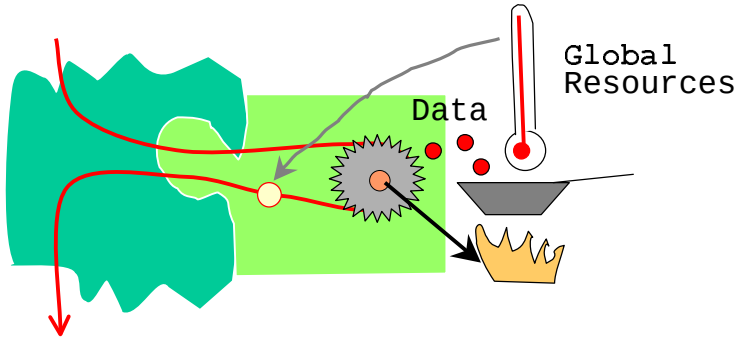
Example: Monitoring (2)

- Capture interactions to analyze program behaviour



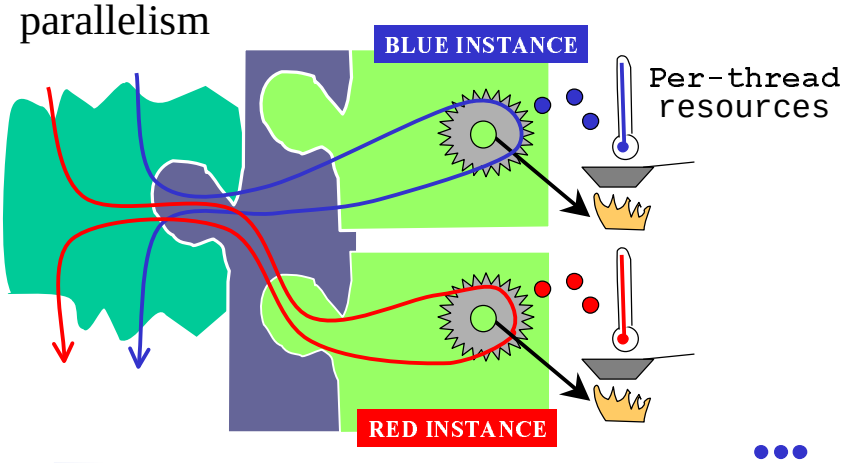
Example: Transformation (1)

- Replicate functional units to increase parallelism



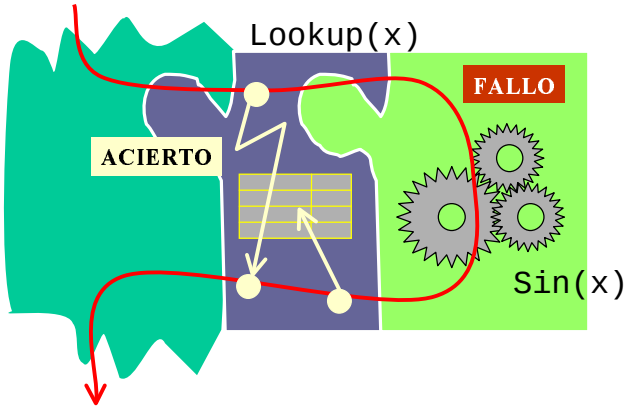
Example: Transformation (2)

- Replicate functional units to increase parallelism



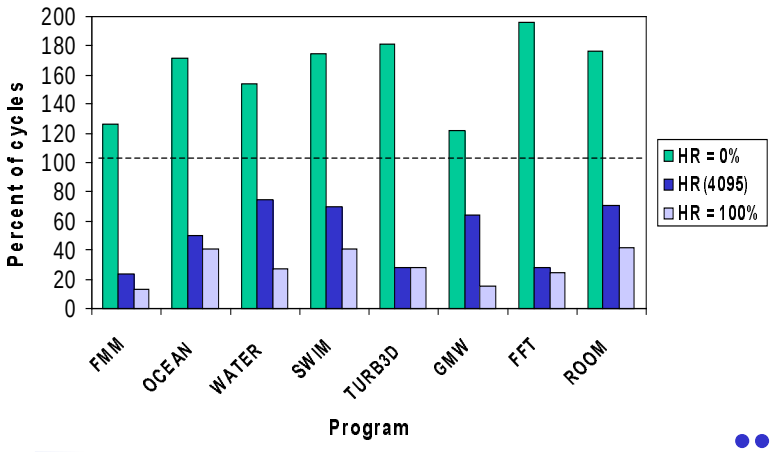
Example: Improvement (1)

- Speed up mathematical services
  - Idea: result reuse



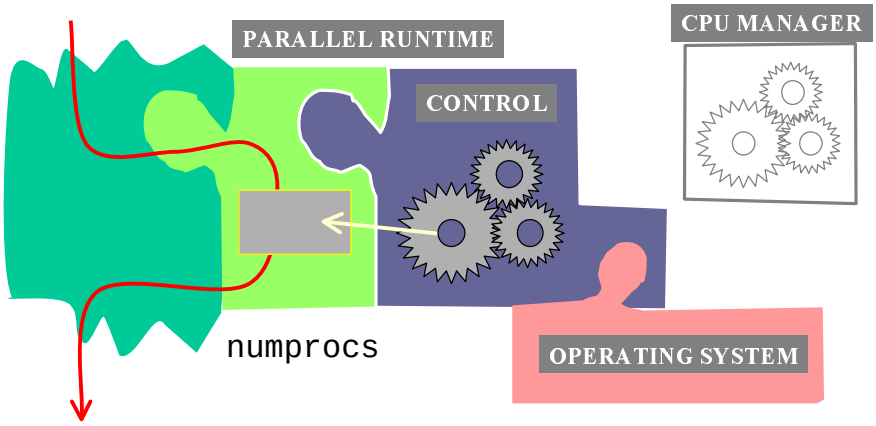
Example: Improvement (2)

- Speed up mathematical services



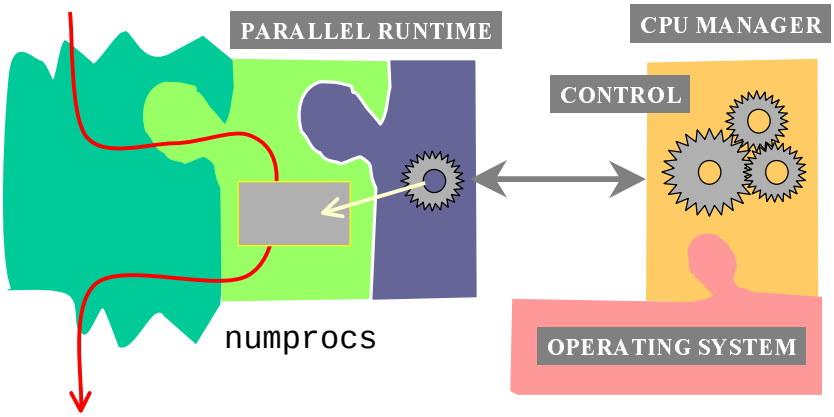
Example: Rapid Prototyping (1)

- Change processor management



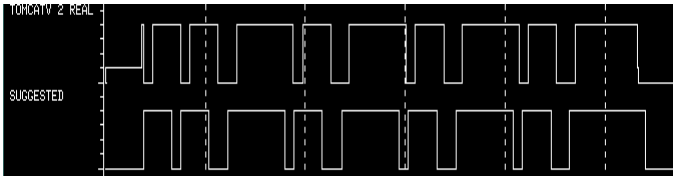
Example: Rapid Prototyping (2)

- Change processor management



Example: Rapid Prototyping (3)

- Change processor management
  - TOMCATV, 4 processors, round-robin



Summary

- DITools: Tools for extensibility
  - Current trend in Operating Systems
- Can be used to solve HPC problems
  - Profiling
  - Tuning
- In conjunction with expert knowledge enable monitoring and program transformation.
- SGI-IRIX prototype
  - gsomk@ac.upc.es