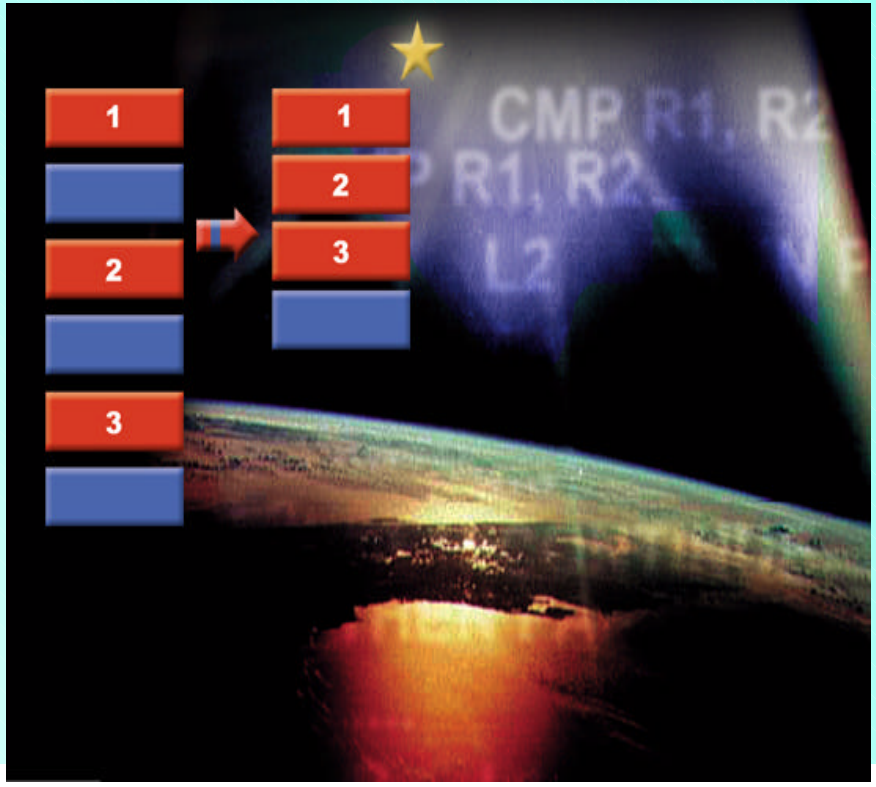
Case Study on Performance Tuning of Applications

Gadi Haber
Vadim Eisenberg
Marcel Zalmanovici



Source-level Performance Tuning

- A way for identifying and resolving logical & algorithmic issues in performance early in development stages
- Enables to address performance issues throughout the development life cycle
- Helps building an accurate performance modeling
- Performance tuning can start from Unit Test stage on

Source-level Techniques for Handling Performance Issues

- Code Reordering & Code re-partitioning
- Memoization
- Function Inlining & Specialization
- Tuning Hot loops using history information
- Field Packing
- Software Caching

Identifying Performance Issues

- When using **representative** input workload, logical profiling of the code can identify
  - Hot vs. Cold code
  - Hot loops
  - Hot memory references of load instructions
  - Hot I/O operations

Code Reordering & Re-partitioning

- Separating Hot code from Cold code - done by relocating
  - rarely executed segments of code
  - error-handling modules
- Turning Hot code segments into functions - for hot segments that are called from multiple places
- Performing memoization - for computational functions or code segments
- Function inlining & Specialization - for functions that are called from a single dominant site

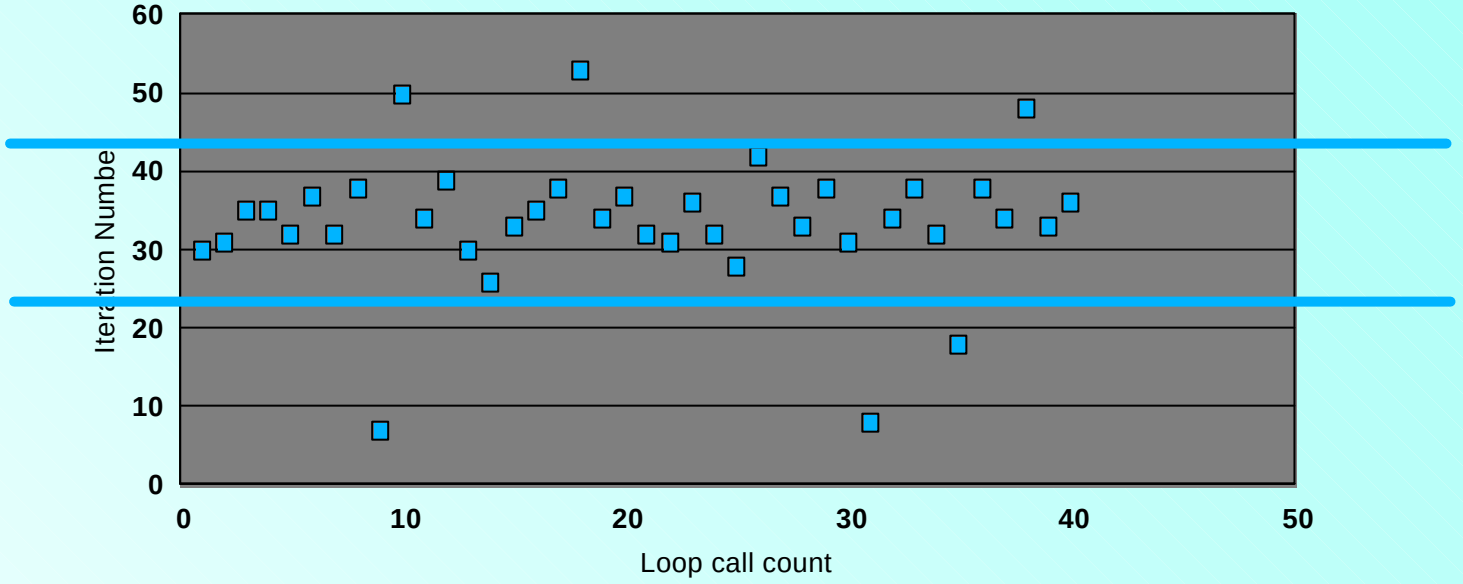
Tuning Hot Loops

- **Hot loops are characterized by:**
  - performing a large number of iterations
  - being called a large number of times

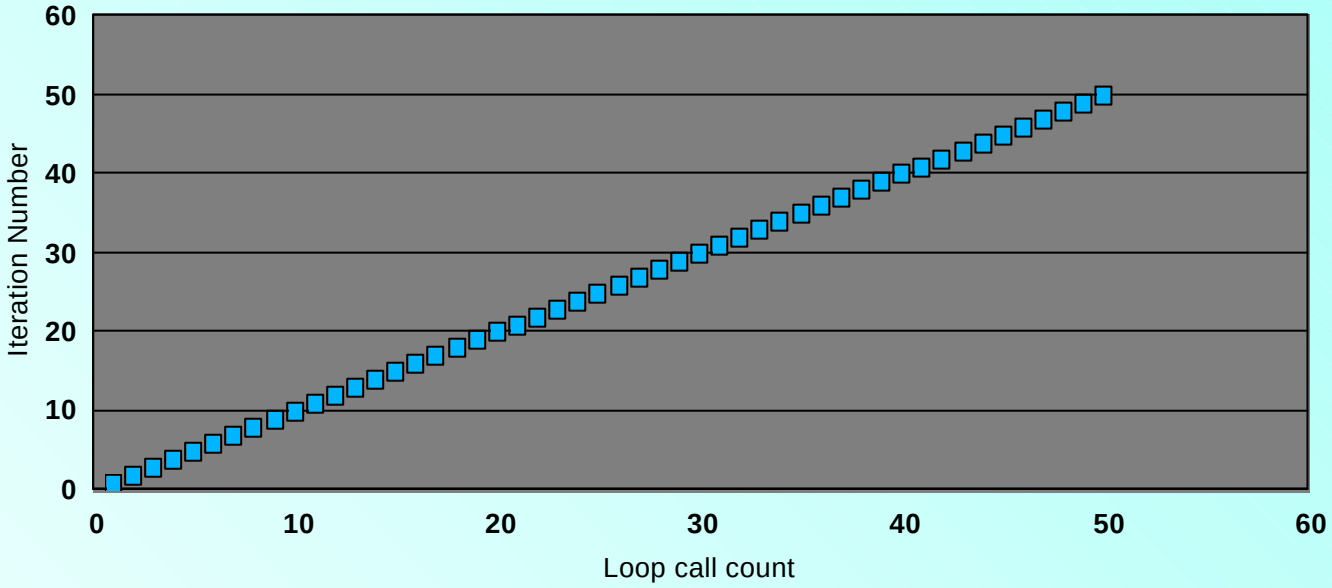
Tuning Hot Loops - (continued)

- **3 Important cases of Hot loops:**
  1. loops performing a certain computation
     - Maintain temporal computational results for future loops' invocations
  2. loops performing heavy I/O operations
     - Map I/O into memory (when possible)
  3. loops searching in or traversing thru data structures
     - Maintain pointers to frequently referenced elements to be used for future searches of the loop

Hot Loops - Bounded Behavior Example



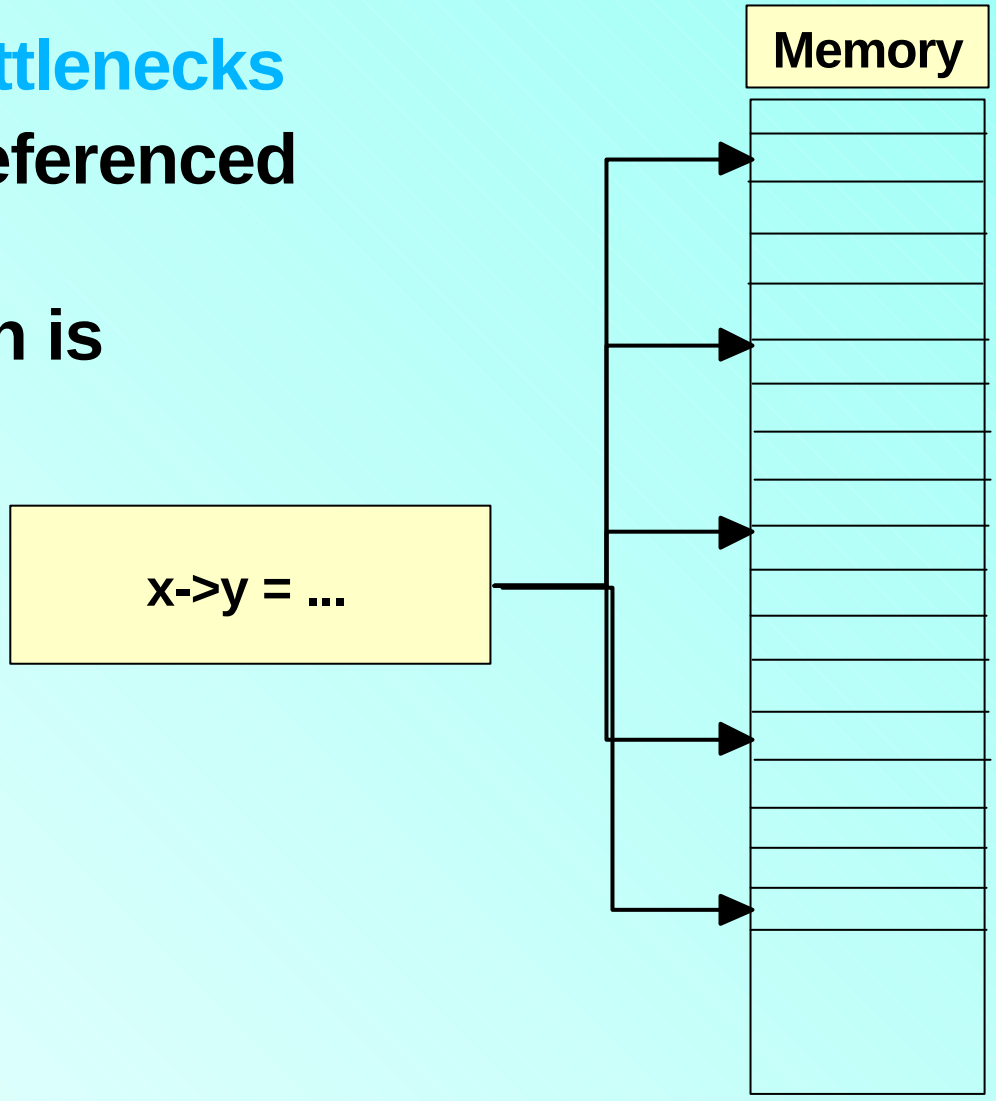
Hot Loops- Linear Behavior Example



Improving bottlenecks in Data $

Two possible cases of bottlenecks

1. **Distances between referenced addresses are large**
2. **The references pattern is irregular**



Improving bottlenecks in data $ - (cont'd)

- **How to handle data $ bottlenecks**
  - When the average stride between referenced memory addresses is large, i.e., the addresses are located far from one another
    - Perform Field Packing
  - When no average stride exists, i.e., the instruction "jumps" irregularly between memory locations
    - Perform software caching or replace the allocation algorithm of the referenced data structure