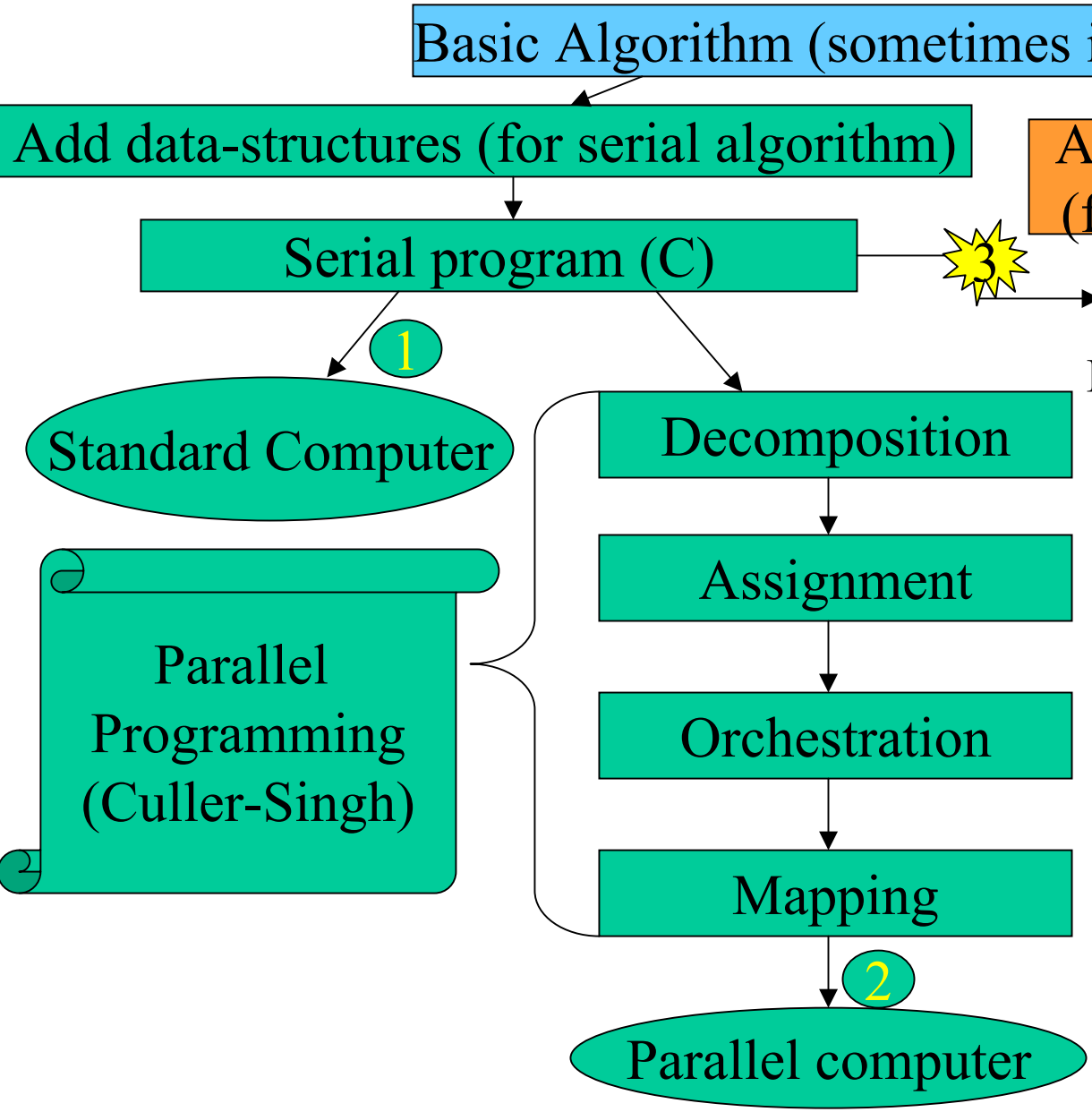
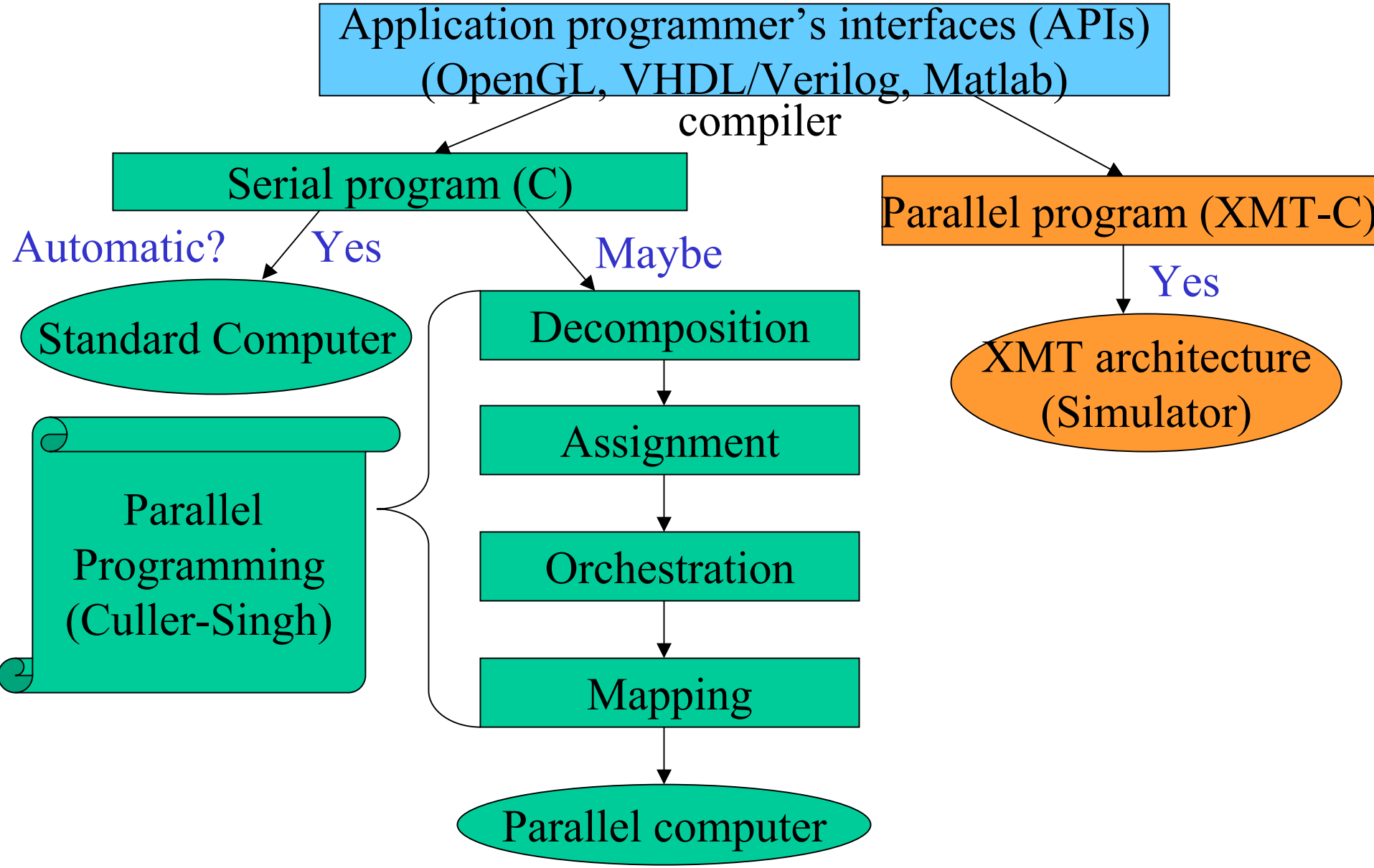
# PERFORMANCE PROGRAMMING & ITS PRODUCTIVITY




- 4 **easier** than 2
- Problems with 3
- 4 competitive with 1:

cost-effectiveness; natural - HPCS puts to the test the practicality of the rich PRAM algorithmic theory and the UMD PRAM-On-Chip project

# APPLICATION PROGRAMMING & ITS PRODUCTIVITY



## PRAM: parallel random-access virtual machine model

- Ideal PRAM: latency for arbitrary number of memory accesses, same as for one access.
- Premise: algorithmicist states (or, does not hide..) what can be done concurrently.
- Algorithmic knowledge-base 2nd only to serial algorithms.
- Simplest parallel model.

# EXAMPLE

Given: (i) All world airports. (ii) For each, all airports to which there is a non-stop flight.

Find: smallest number of flights from DCA to every other airport.

**Basic algorithm**

Step i: Given all airports that require i-1 flights, find (concurrently!) all those that require i flights.

**Serial**: uses "serial queue".

- O(T) time; T – total # of flights

**Parallel**: parallel data-structures.

- Inherent serialization: S - # of parallel steps: ~L. Total # of operations: ~T.

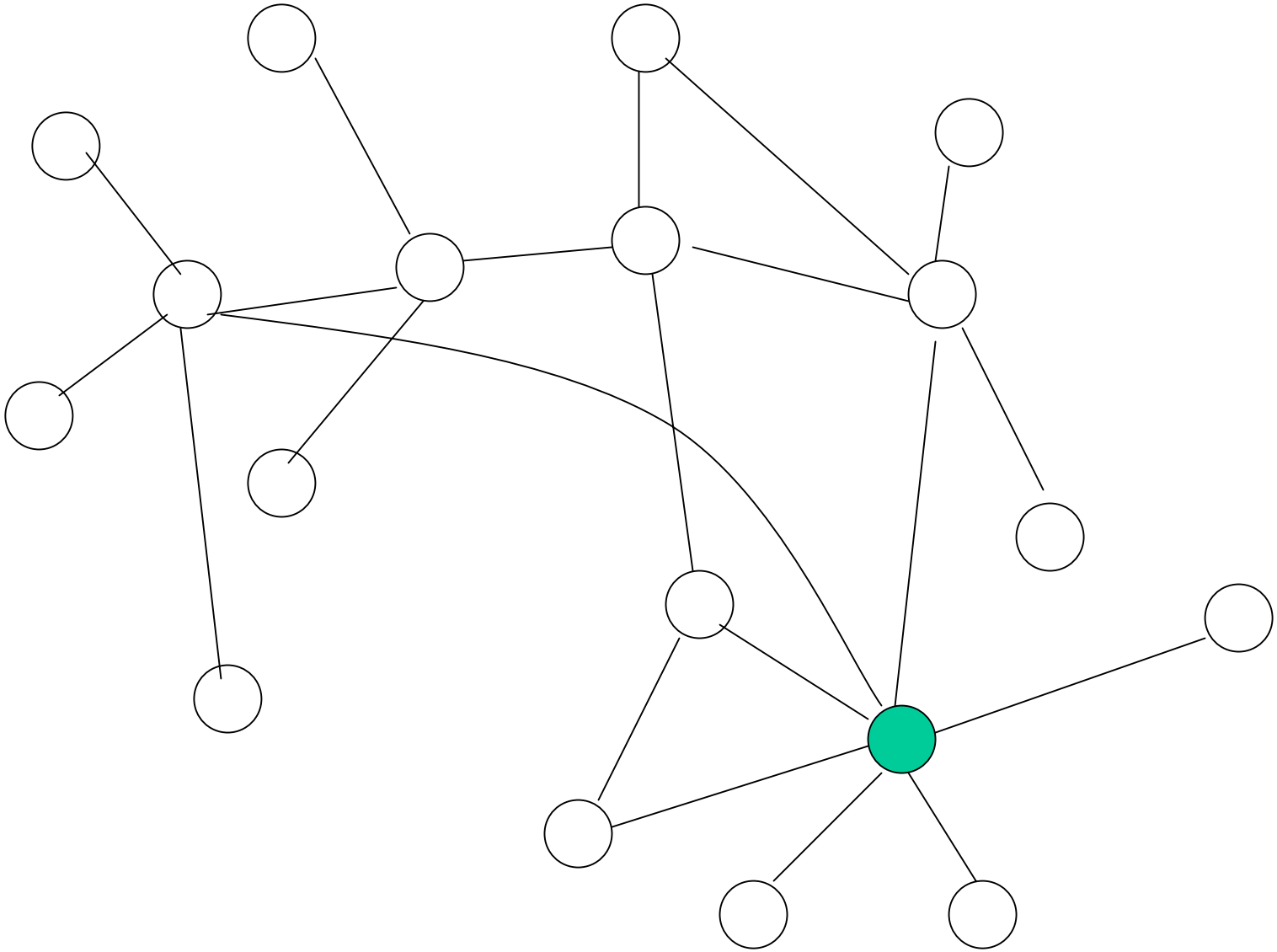
**Gain relative to serial**: (first cut) ~T/S!

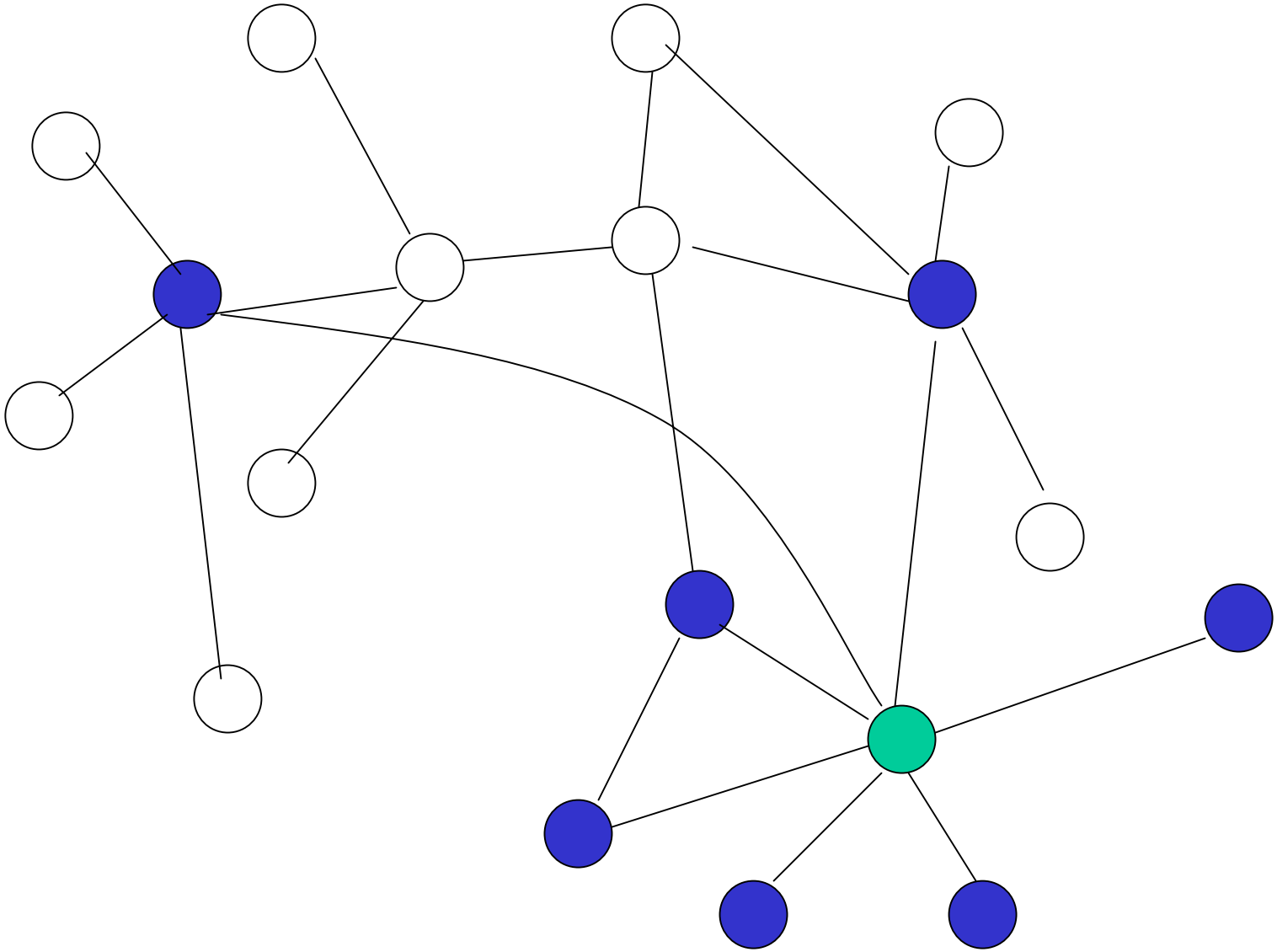
Note: log(deg(G)) factors in parallel time and # of ops. Still: decisive!

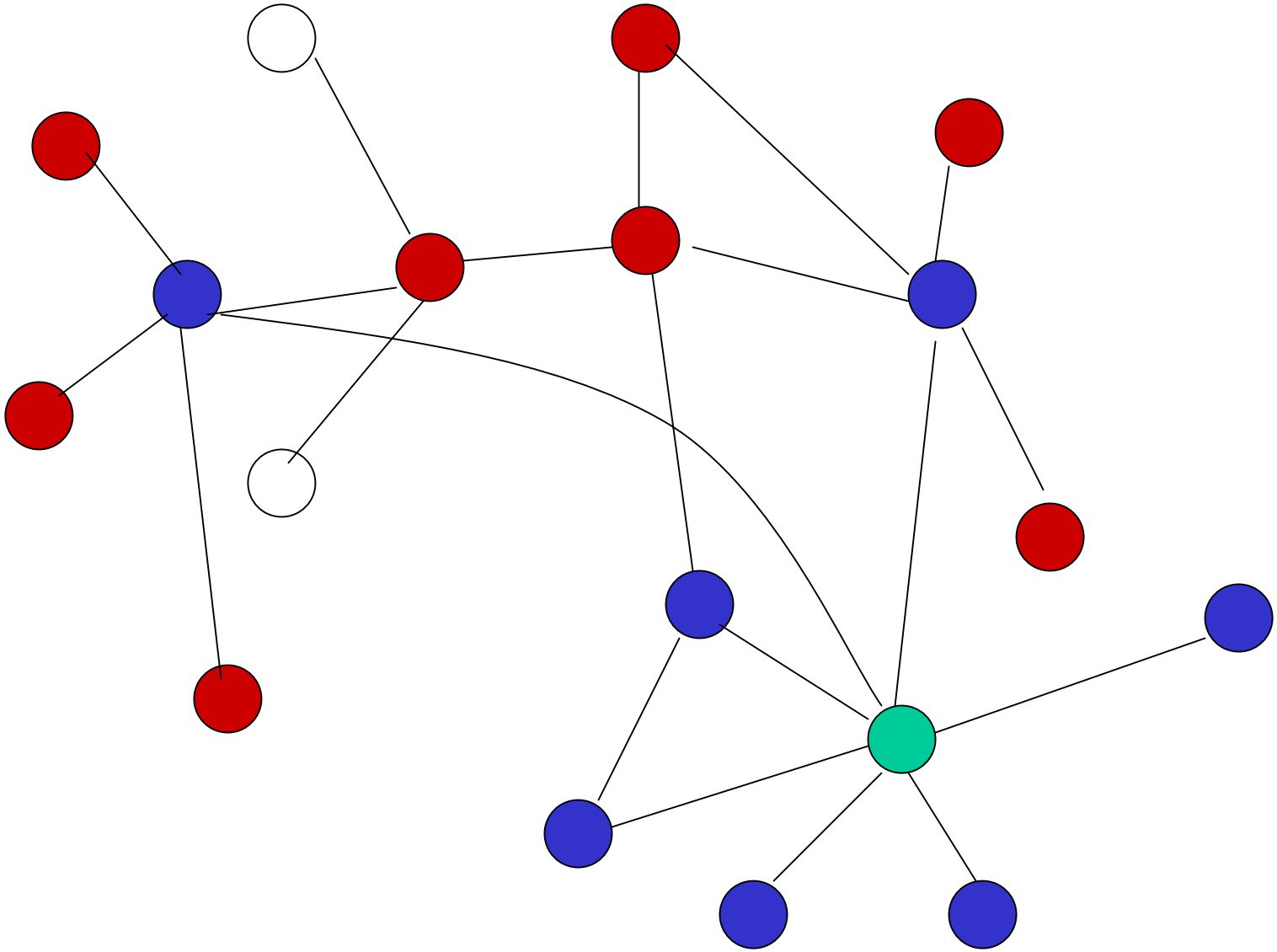
- decisive gain also relative to coarse-grained parallelism

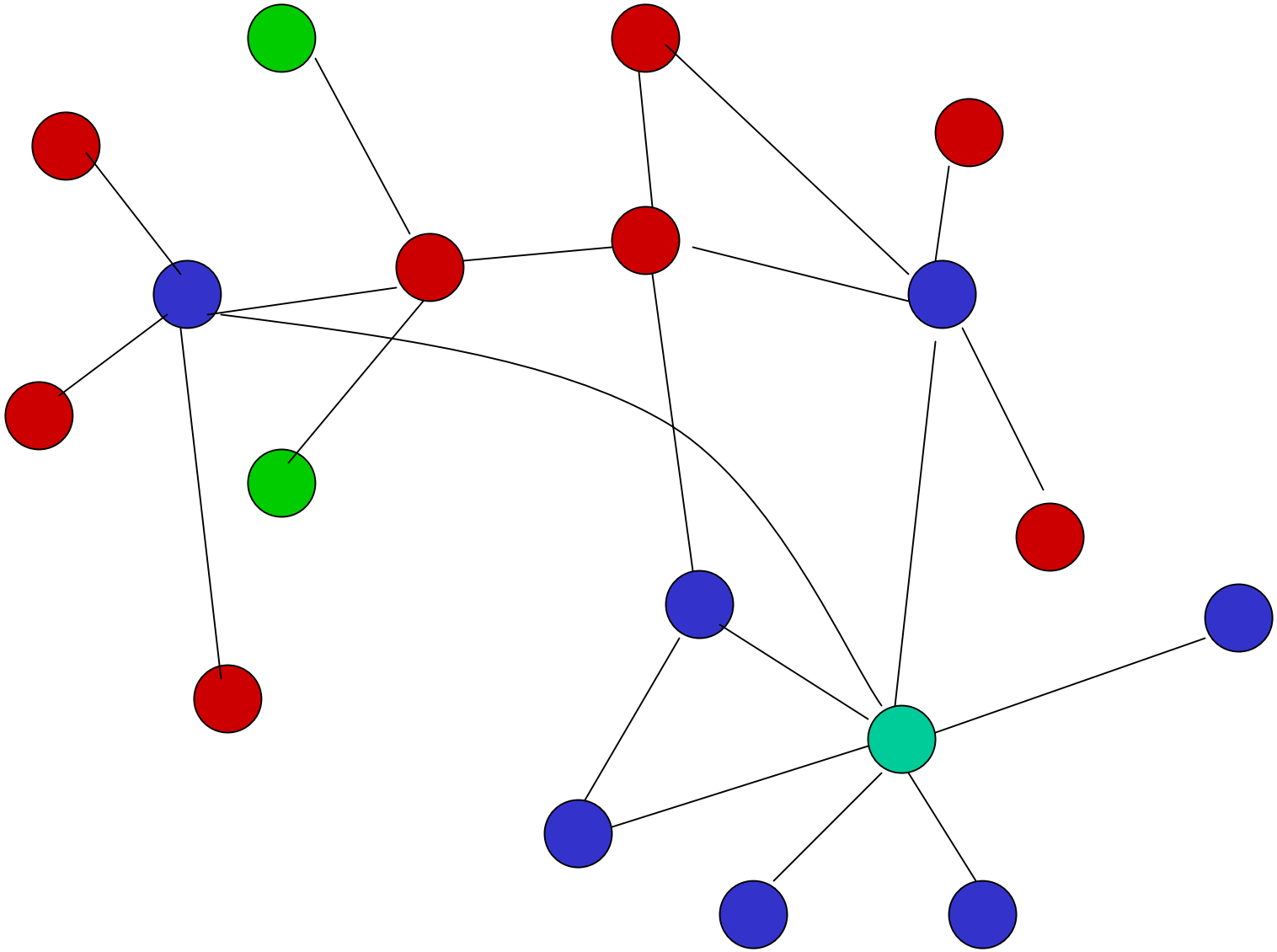
- **Conclusion**:

- Easy to program (natural!)









- Course: **Parallel Algorithmics, Vishkin@UMD (CMSC751/ENEE759K Spring 2004)**
- Technology: **XMT C (C extension based on PRAM model)**
- Platform: **simulator of XMT architecture**
- Students: **14**
- Assignments: **2**
  1. **Array compaction**
  2. **Randomized selection**
- Hypotheses:
  - **For many problems, developing a parallel program is more natural than first developing a serial program, then parallelizing**
  - **XMT C programming is easier than other parallel programming approaches**
- Data collection:
  - **Data collection scripts capture reason for compile, compile timestamp, source code**

- Name**: Array Compaction**
- Development Models**: Transform given serial into XMT**
- Grading Criteria**: not specified to students**
- Description:
  - **Compact elements of array A into array D according to binary array C**
    - **If C[i] (0<=i<=N) is equal to 1 then A[i] is copied into next free element of D**
    - **To get the next free element in D a prefix sum (ps) instruction is used.**

- Name: **Randomized Selection**
- Development Models: **Derive a serial and a parallel implementation**
- Grading Criteria: **not specified to students**
- Description:
  - **Use XMT to implement parallel and serial programs for the following standard (expected linear time) iterative randomized algorithm:**

    **pick a random element r**

    **rank it**

    **check for termination**

    **iterate on a subset of the elements.**

# Reported speed-ups for a 1024-TCU (thread-control unit) XMT