Final Exam Review

FR-1

General Information

Tuesday, 9 December 1997, 10:00–12:00 CST.

Open book, open notes.

Two hours, this room.

Bring anything except a communication device.

Three regular problems.

One set of short-answer questions.

Major Topics

- Overview of Parallel Processing
- Performance Model
- Major Network Types
- Network Measures
- Direct Networks
- Flow Control
- Deadlock-free Routing
- Buffering
- Permutation Families
- Mathematical Representation
- Equivalence
- Delta and Bidelta Networks
- Circuit Switching Definitions
- Clos Networks
- Benes Networks
- Generalized Connectors
- Sorters, Balancers, and Counters

Overview of Parallel Processing

Identify, know role of:

tasks, processors, network.

Performance Model

Know how equation parts relate to modeled system.

Know sequence of events as modeled program runs:

computation, message sending.

Major Network Types

Know distinguishing features of each.

- Bus: Shared Medium
- Direct: nodes connected by links.
- Crossbar: crosspoint for each input/output pair.
- MIN: Cells organized into stages, ...

Network Measures

Structure:

Diameter, average distance, bisection width, degree.

Performance:

Latency, throughput.

Message Structure and Flow Control

Relationship between:

Message and packet.

Inputs, outputs, requests, and connection assignments.

Direct Networks

Graph Specification

Convert between

set $G = (V, E)$ description, drawing, verbal description, etc.

Node Structure

Relationship between node, crossbar, processor, and links.

Moore Bound

Derivation

The k-ary n-Cubes, n-Dimensional Meshes

Description, measures

Routing

Important features: simple routing, many algorithms, etc.

The de Bruijn and Shuffle-Exchange Networks

Description, measures.

Routing.

Important features: small diameter, etc.

Omega Networks

Structure, routing, measures.

Find path taken by a request.

Types: generalized, modified.

Buffering and Flow Control

Queue placement and connection to crossbar.

Deadlock Free Routing

Virtual-channel flow control.

Permutation Families

Major Families

Shift

Bitonic (Spreading, Packing)

Admissibility Proofs

Admissibility function.

Mathematical Representation

Convert between: LGM, CGM, sets of permutations representations.

Equivalence

Know definitions of:

Descriptive, terminal, topological, and functional equivalence.

Be able to prove or disprove for a pair of networks.

Equivalence results for networks presented in class.

Delta and Bidelta Networks

Definitions

Path descriptors and dual-path descriptors.

Relationships

Banyan and Delta

Delta and Bidelta

Topological equivalence of any two bidelta networks.

Circuit Switching Definitions

Rearrangeable

Non-blocking, strictly non-blocking, wide-sense non-blocking.

d-limited generalized connection assignments.

Clos Networks

Non-Blocking

Definition, proof that it's non-blocking.

Rearrangeable

Definition.

Proof that it's rearrangeable.

Hall's theorem. (Statement, but not proof of Hall's theorem.)

Proof of Clos network rearrangeability.

Routing. (The looping algorithm.)

Application of algorithm.

Beneš Network

Beneš Network Basics

Definition.

Recursive looping algorithm application and run time.

Beneš/Clos Network Correspondence

Mapping between cells in a Beneš and Clos network.

Use for routing.

Implication for Clos network input- and output-stage cells.

Generalized Connectors

Pack/Copy/Permute Type

Clos Type

Fanout/Concentrate Type

Sorters, Balancers, and Counters

Sorters

Definitions

Compare/exchange (CE) element.

Comparison network.

Sorting network.

Zero/One Theorem

Proof, application.

Balancers and Counters

Balancing element.

Definition of balancing and counting network.

Construction.

Applications.