CPE 633
Chapter 1 - Preliminaries

Dr. Rhonda Kay Gaede

UAH

Motivation

- Computers are everywhere.
- Computers are used in _____________ and _______________ applications.
- Computer systems (_____________ and ___________) are incredibly _________.
- With complexity comes a propensity for ___________.
- Two approaches:
  - ___________________
  - ___________________________________

1.1 Fault Classification

- Definitions
  - A fault (or failure) can be either a ________________ or a ________________
  - An _____ is a manifestation of the _____.
- Examples
  - Output of adder circuit ____________
  - sin(x) computation really __________
- Fault effects can ____________.
- To limit this spread, designers incorporate __________________________.

1.1 Fault Classification

- These containment zones are __________ that reduce the chance that an effect can spread.
  - ______________________________________ ______.
- Hardware faults can be:
  - ______________
  - ___________
  - ________________
- Hardware faults are __________ or ________________.

1.2 Types of Redundancy

- All of fault tolerance is an exercise in ____________ and ___________ ________________ – the property of _________________________ than is minimally necessary.
- Four forms of redundancy: _________, ____________, ________, _____________
- Hardware redundancy is provided by _________________________ in the design to ________ or ________ errors.
  - It can be _______, _______ or _______.

1.2 Types of Redundancy

- The best-known form of ___________ redundancy, ______________ and ____________ coding, is widely used in ______________________.
- ________________ and _____________ codes are also used to protect data communicated over ________ (channels subject to many ________ failures) channels. ___________ upon detection of an error is ______ redundancy.
- ____________ redundancy leads to hardware ___________.

1.3 Basic Measures of Fault Tolerance

- What does it mean to make machines more ___________________?
  - We need _________
- Traditional Measures
  - ____________, _____, is the probability that the system has been ________________ in the time interval [0,t]. It is suitable for applications in which even a _____________________ can prove costly.
    - ______________________ (MTTF)
    - ________________________ (MTBF)
    - __________________ (MTTR)
    - ______ = ______ + ________

1.3 Basic Measures of Fault Tolerance

- _____________, _____, is the average ____________ ______ over the interval [0.t] that the system is _____.

$$A = \lim_{t \to \infty} A(t)$$

$$A = \frac{MTTF}{MTBF} = \frac{MTTF}{MTTF + MTTR}$$

- _____________________, ______, is the probability that the system is up at _______________________ ___________.

1.3 Basic Measures of Fault Tolerance

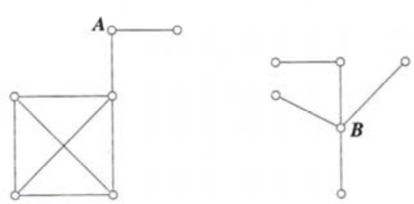
- All this is nice as long as we know what ____ means.
  - Some cases are simple, _______________ for example.
  - Other cases not so much, what if ___________________ _______________________________________?
  - Many systems have ______________ states
- Extension of traditional measures to ____________ __________________________________ of a system with n processors.

$$ACC = \sum_{i=1}^{n} c_i P_i(t)$$

- C_i is the ________________________ of a system with I ________________ processors
- $P_i(t)$ is the probability that exactly ______________ are operational at time t

1.3 Basic Measures of Fault Tolerance

- Network Measures
  - Classical ______ and _________________ – the minimum number of _________ and _________ that have to fail before the network becomes _____________________.
  - Average _____________________
  - Maximum ________________ (_____________)



Network N1 Network N2