Immune Inspired Fault Tolerance

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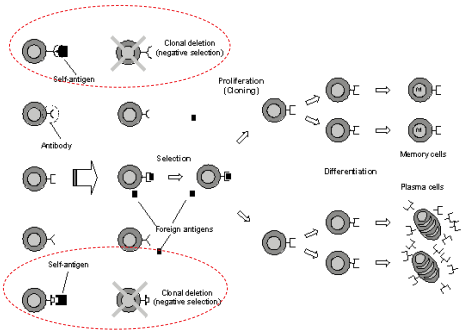
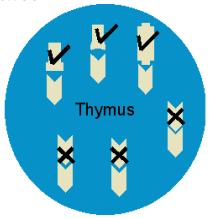
The immune system

Clonal selection

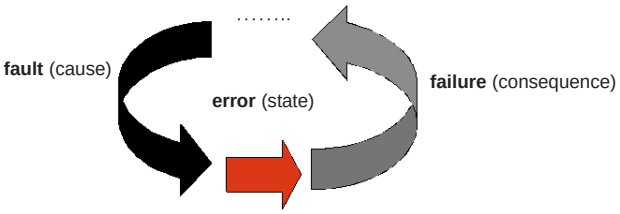


Self and nonself discrimination (Negative selection)

- The immune system needs to distinguish between self and nonself to function normally
- Otherwise, the immune system attacks self (autoimmunity)
- How does the immune system distinguishes between self and nonself ? – Negative selection
- A process of T-cell maturation in the thymus
- Destruction of self recognising T-cells
- Preservation of nonself recognising T-cells



Why fault tolerance?



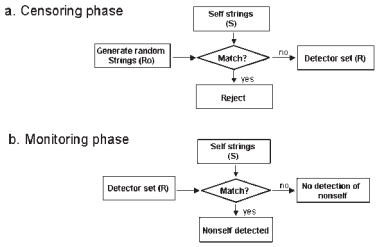
- Fault tolerance enables the provision of service despite the presence of faults in the system, for improving its reliability and availability
- This is achieved by applying the techniques and mechanisms for error processing and fault treatments

Immune system + fault tolerance

- The immune system needs to distinguish between bad and good guys
- This is achieved by self and nonself discrimination
- Fault tolerance involves detection of error states
- This requires a distinction between error states and non-error states?
- This discrimination requirement is common to both the immune system and fault tolerance
- Is it possible to solve this discrimination problem in fault tolerance by learning from self and nonself discrimination of T-cells in the immune system?

Negative selection: A metaphor for computational intelligence

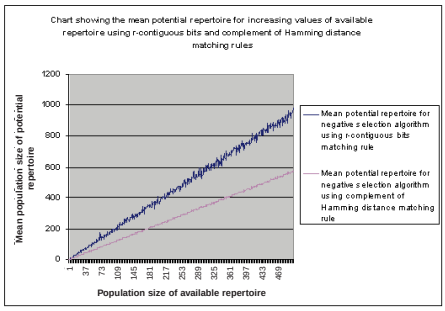
- Negative selection algorithm for change detection



Negative selection: A metaphor for computational intelligence in fault tolerance domain

Immune system	Fault Tolerance Domain
Self molecules	Error (normal) states/behaviours
Nonself molecules (antigenic patterns)	Non-error (abnormal) states/behaviours
T-cells	Error detectors
Potential repertoire	Candidate detectors
Available repertoire	Competent detectors

Investigating effect of matching rules on negative selection algorithm



Future directions

- Artificial Immune Systems (AIS)
  - Suitability of negative selection technique to fault tolerance
  - Examination of other AIS techniques
  - Hybridisation of AIS techniques
  - Scalability?
  - Representation for immunised fault tolerance
- Fault Tolerance
  - Error recovery
  - Fault prediction

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