Thinking...

...***inside*** the box

Robustness in Behavior Modeling

Soar Technology

3600 Green Court, Suite 600
Ann Arbor, MI 48105
(734) 327-8000
www.soartech.com

Problem

- Widely held perception that human behavior models are too brittle
- The brittleness of current behavior systems severely limits their effectiveness
- Error is inevitable
  - Errors will occur in any non-trivial system
  - Most computer systems don't handle it well
- Failures cost time and money
  - Contributes to poor usability, poor productivity, poor training, poor planning
  - Inability to adapt requires custom development for each new situation
- Standard approaches are inadequate

Statement of Purpose

The objective of the Robustness in Behavior Modeling project is to:

- Develop methodologies for robustness
- Demonstrate application of these methodologies in a non-trivial application
- Describe how this approach will generalize to other applications

Basis of Brittleness

- Aptness to break
  - Increases as program is applied in domains for which it was not originally designed
- Brittleness in an intelligent system is a knowledge problem that arises out of ignorance (lack of knowledge) not representation (architecture)
- Arises when knowledge is
  - Inaccurate: knowledge is untrue
  - Incomplete: knowledge is lacking
  - Obsolete: knowledge is no longer true
  - Inconsistent: knowledge contradicts itself
  - Ill-defined: knowledge is too vague to use

TacAir-Soar Example

- Failure to communicate

TacAir-Soar Example

- Failure to communicate

"Range sort"

?

Agent becomes "stuck" when communication target disappears

Why Not Let It Fail?

- Business model for software industry
  - Planned obsolescence
  - Increased cost spread over life-cycle
- Loss of time & training
- Expensive support
- Preserve investment
- User frustration
- Lack of faith in results
- Unacceptable for mission critical applications

How Can We Do Better?

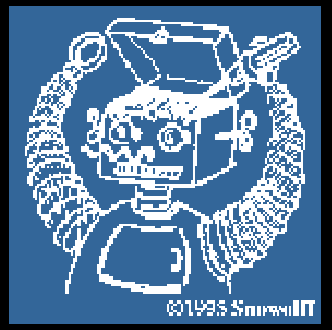
- Biological systems can adapt to new environments
  - Not perfectly, some die, but often adapt
- They monitor their progress
  - Notice when failing and have ultimately failed
- They take “appropriate” corrective actions
- Have redundant and hierarchical systems
- They remember successful actions and use this information in the future
- They anticipate failure and take pre-emptive corrective actions

Executive Dysfunction

- Humans with *executive dysfunction* sometimes act like Soar agents do now
- Stereotypical problem solving
- Perseverence
  - Avoid task switching
- Inability to sustain attention
- Example:

Benefits of Self Recovery

- Believability
  - Learn from, but do not repeat mistakes
- Avoids negative training
- Comprehensible
- Improved reliability
  - Adapts to new environment
- Preserve investment
- Reduce life cycle cost
- Availability
  - Recovery is real time - Bug fixing is not

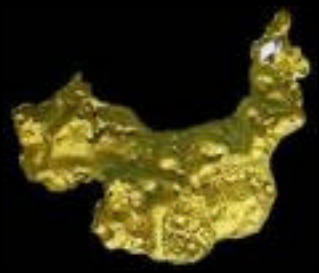


Approach

- Model aspects of biologically inspired recovery mechanisms
  - Show how they generalize
  - Demonstrate these mechanisms are sufficient
- Ground investigation in a specific application
  - A general solution too large in scope to produce tangible results
  - Without context the problem explodes

Recourse

- *Reduce* failure situations
- *Represent* the environment
- *Recognize* progress and failure
- *Resource* allocation
- *Reason* / diagnosis
- *Response* alternatives
- *Recovery* actions
- *Remember* successful approaches



Nuggets and Coal

Failure is inevitable

Some failures are more inevitable than others

We will recover

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