

Stottler Henke

Smarter Software Solutions



Developing A Hidden Domain for Human and Electronic Students

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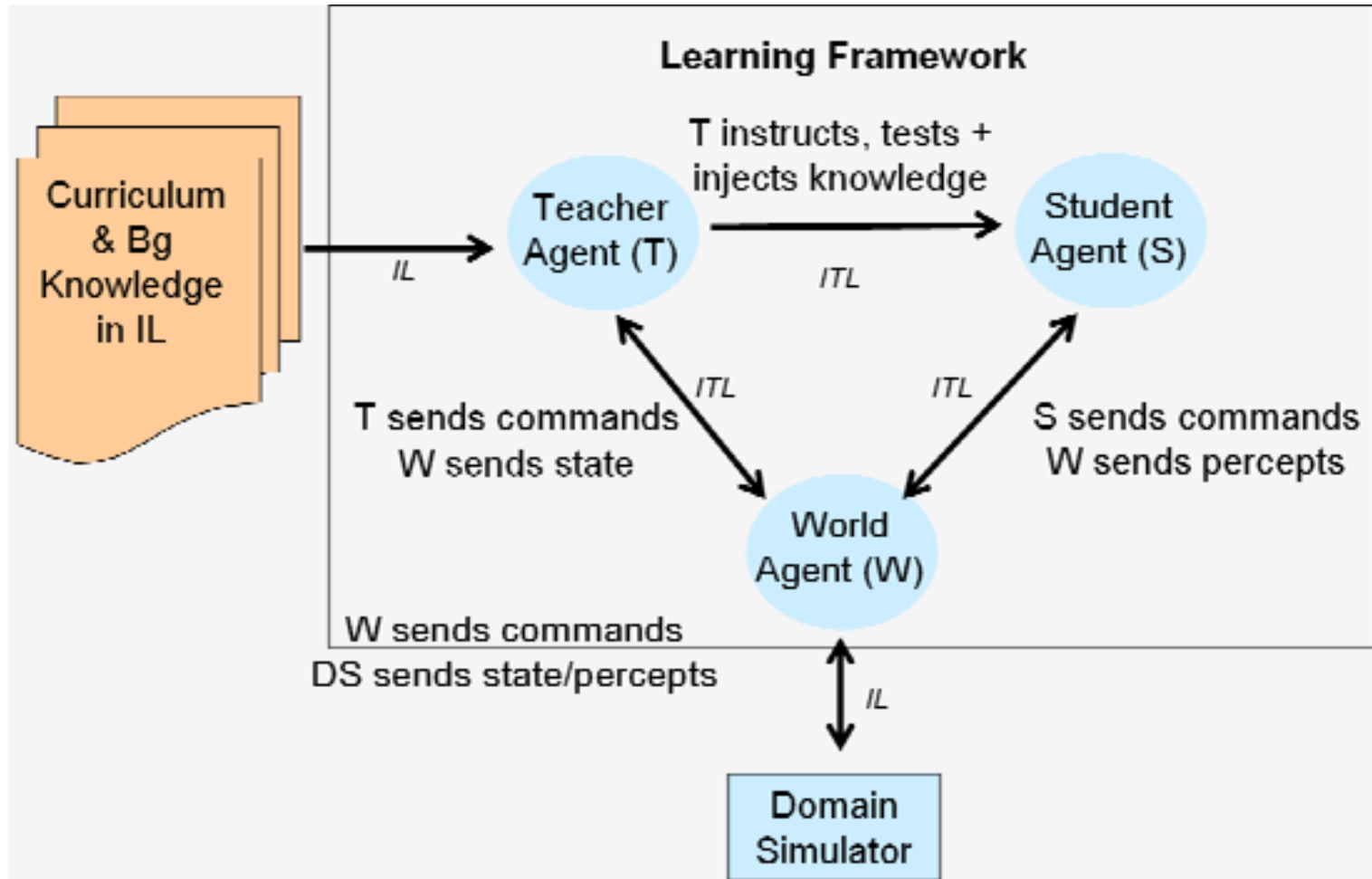
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Bootstrap Learning

Objective: Develop an electronic student (e-student) to learn from focused human-style instruction.

Example: Drawing the letter “p”

Bootstrap Learning Framework



From: Robert D. Grant, David DeAngelis, Dan Luu, Dewayne E. Perry and Kathy Ryall. TOWARDS EVALUATING HUMAN-INSTRUCTABLE SOFTWARE AGENTS, IHCI 2011, Rome, July 2011

Role of Curriculum

1. Instruct the e-student
2. Test the e-student

Advantages of a defined set of curricula:

- Algorithm development
- E-student testing
- Developing a repository

HD Requirements

1. Open to learning from experience
2. Need to learn from experience to succeed
3. Explicit reasoning
4. Elements easily visible to and encoded by an automated system
5. Problems come up reasonably often in real life



Role of Human Comparison

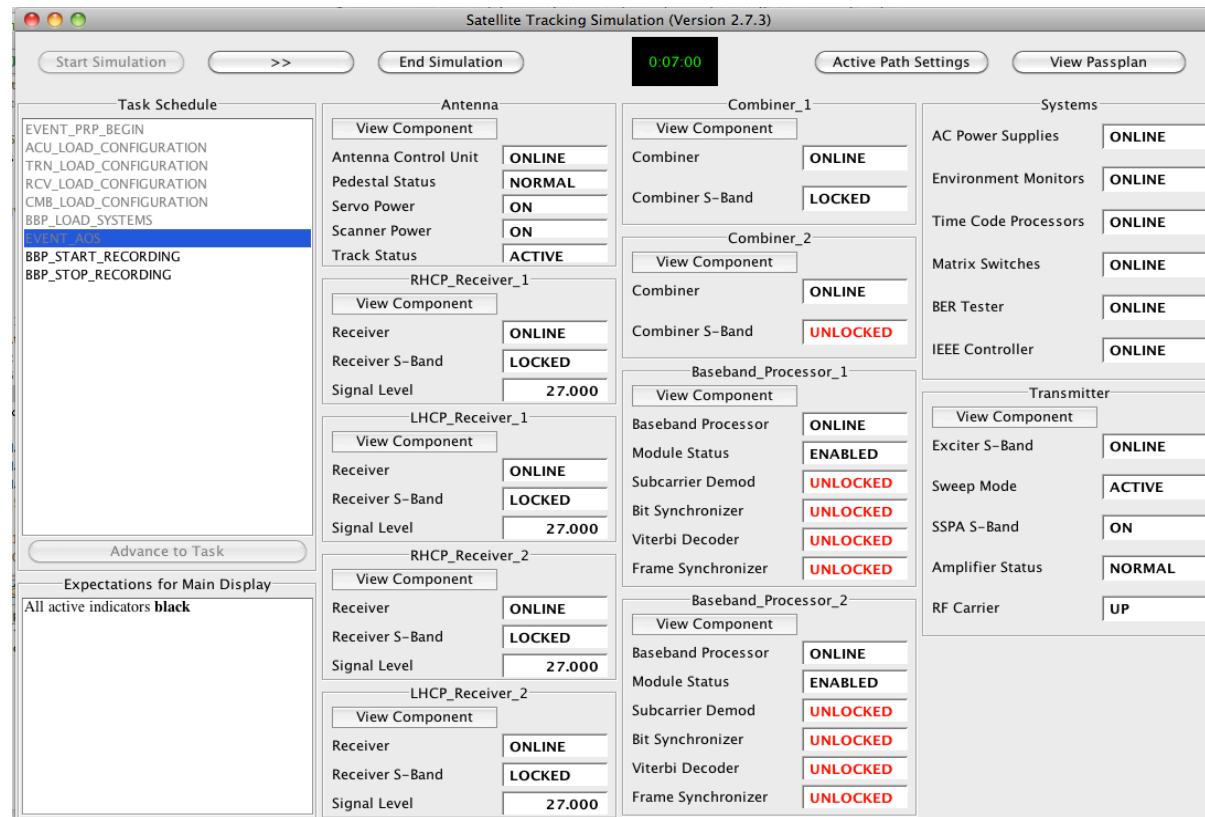
Curriculum is necessary and sufficient

Provide baseline for expected e-student
performance

Human Comparison Requirements

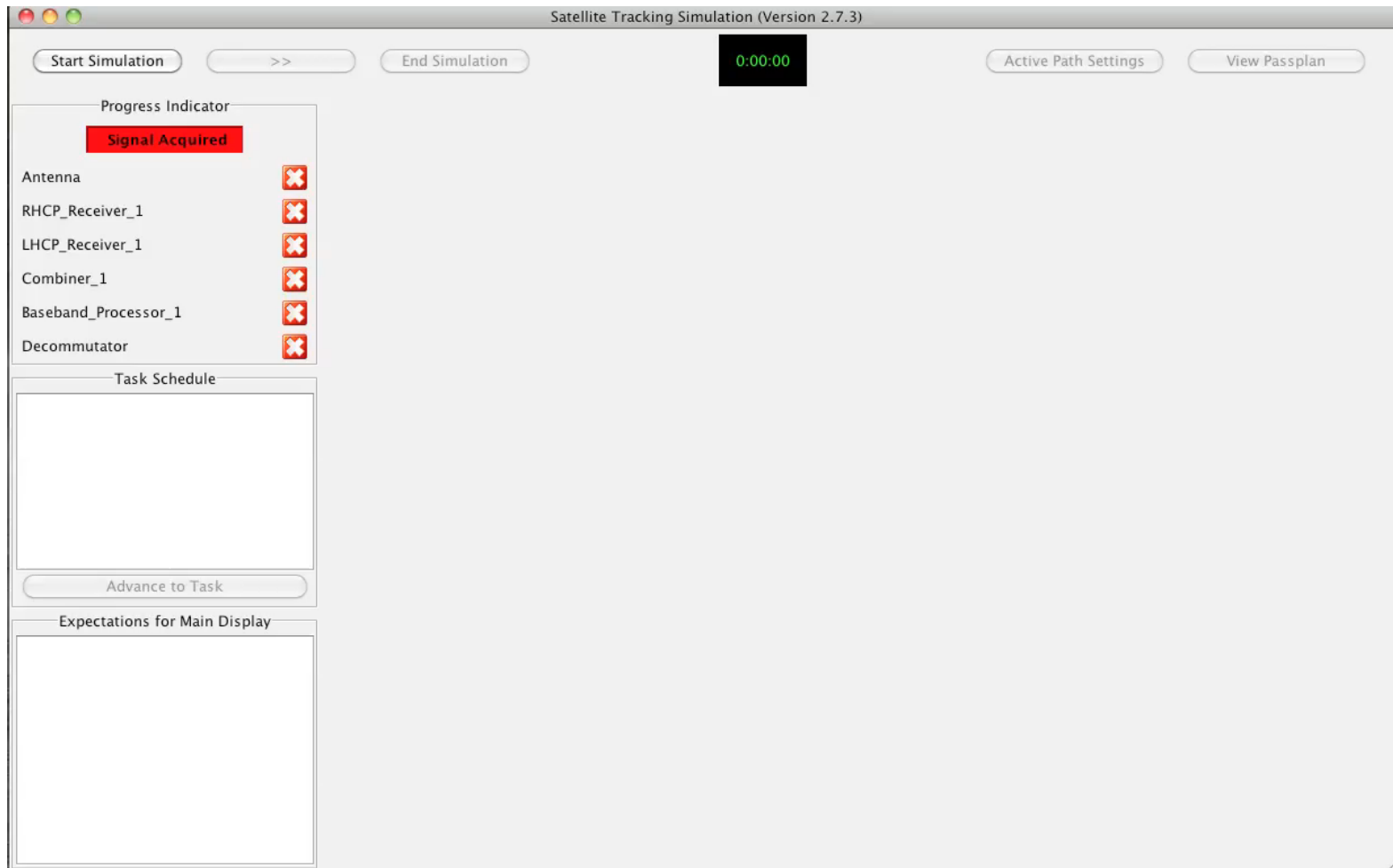
6. Include problems that will challenge the human students.
7. But not too challenging
8. Same problems will be presented to human students and the e-student.

Ground Station Domain



Student fills the role of ground station operator, controlling satellite communication

Demonstration



Laddered Curriculum

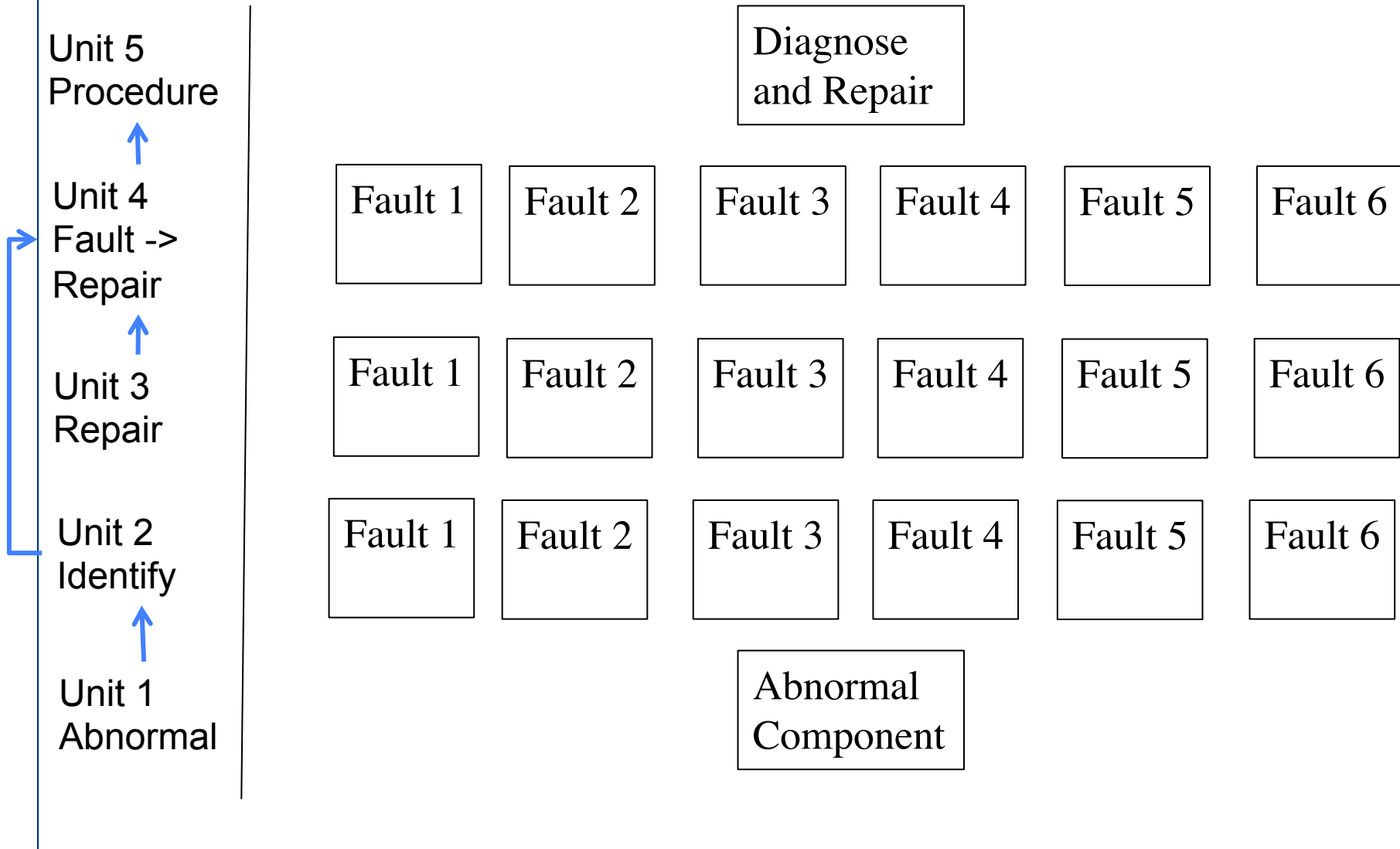
Each rung in the ladder:

- Is single a concept (e.g. procedure, pattern)
- Contains multiple lessons by telling, example, or feedback

Rungs build on top of one another to form a ladder

Units are used to group related rungs

Phase II Laddered Curriculum

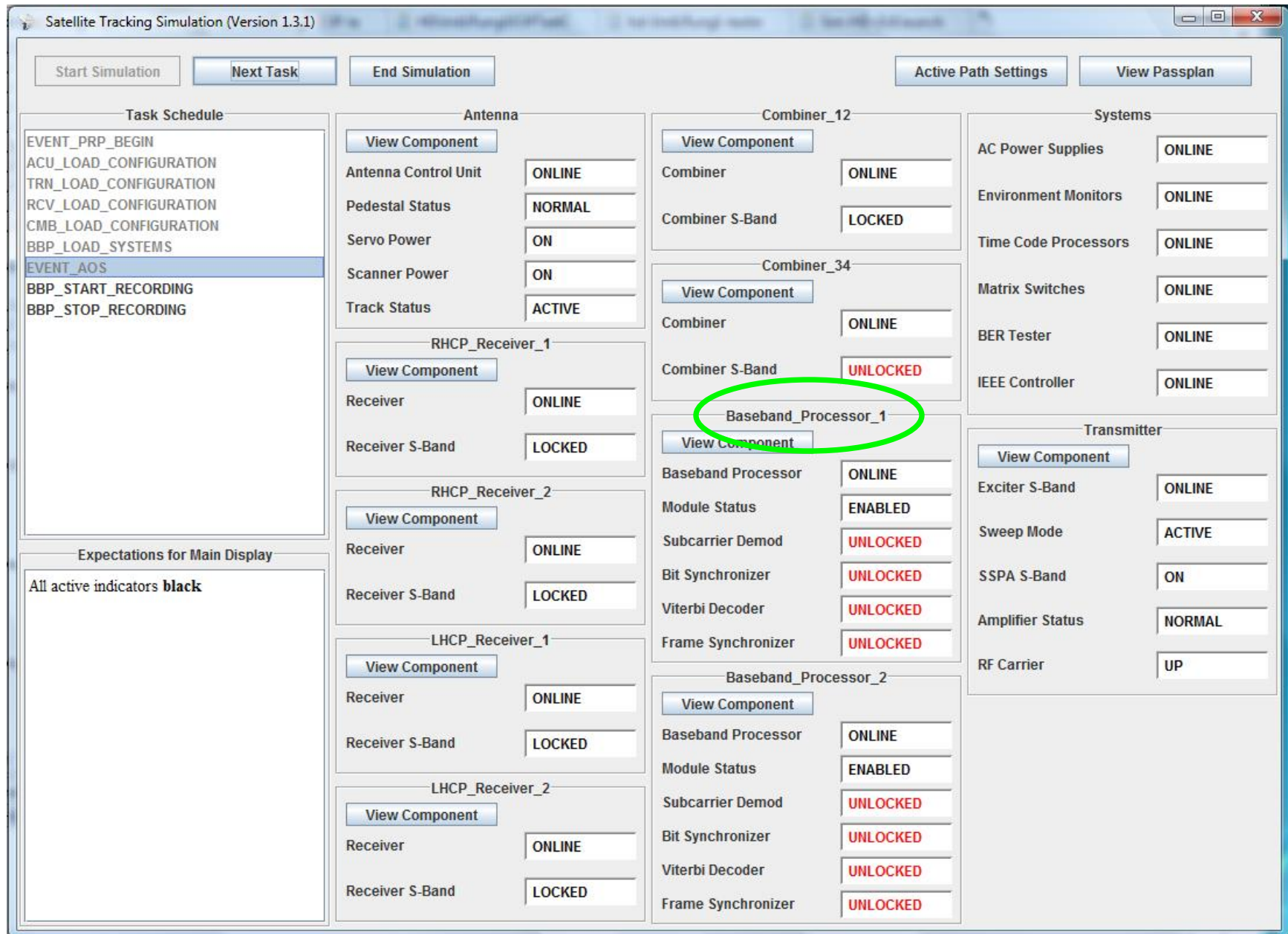


Example Human Lesson

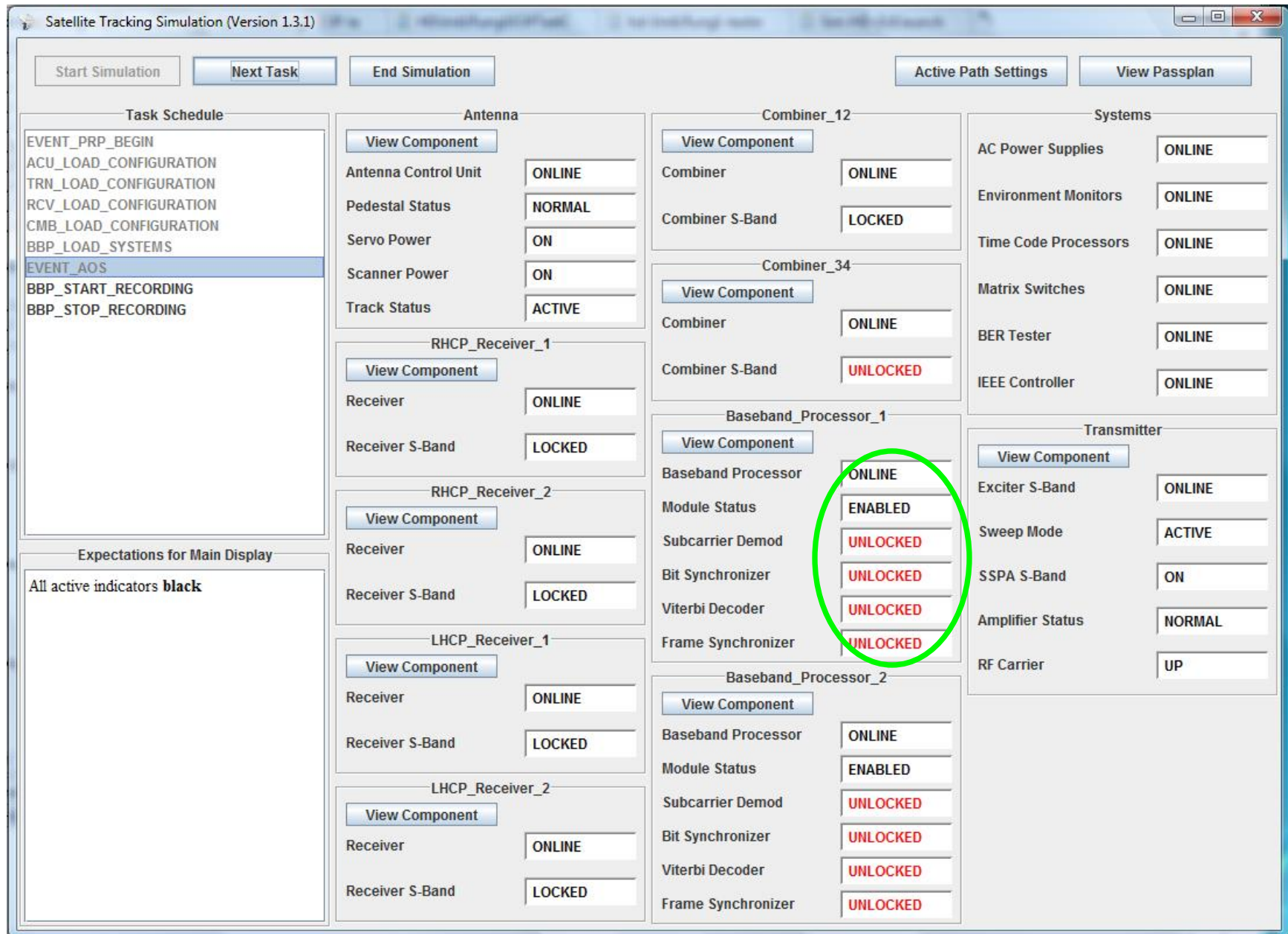
This lesson teaches what *abnormal component* means.



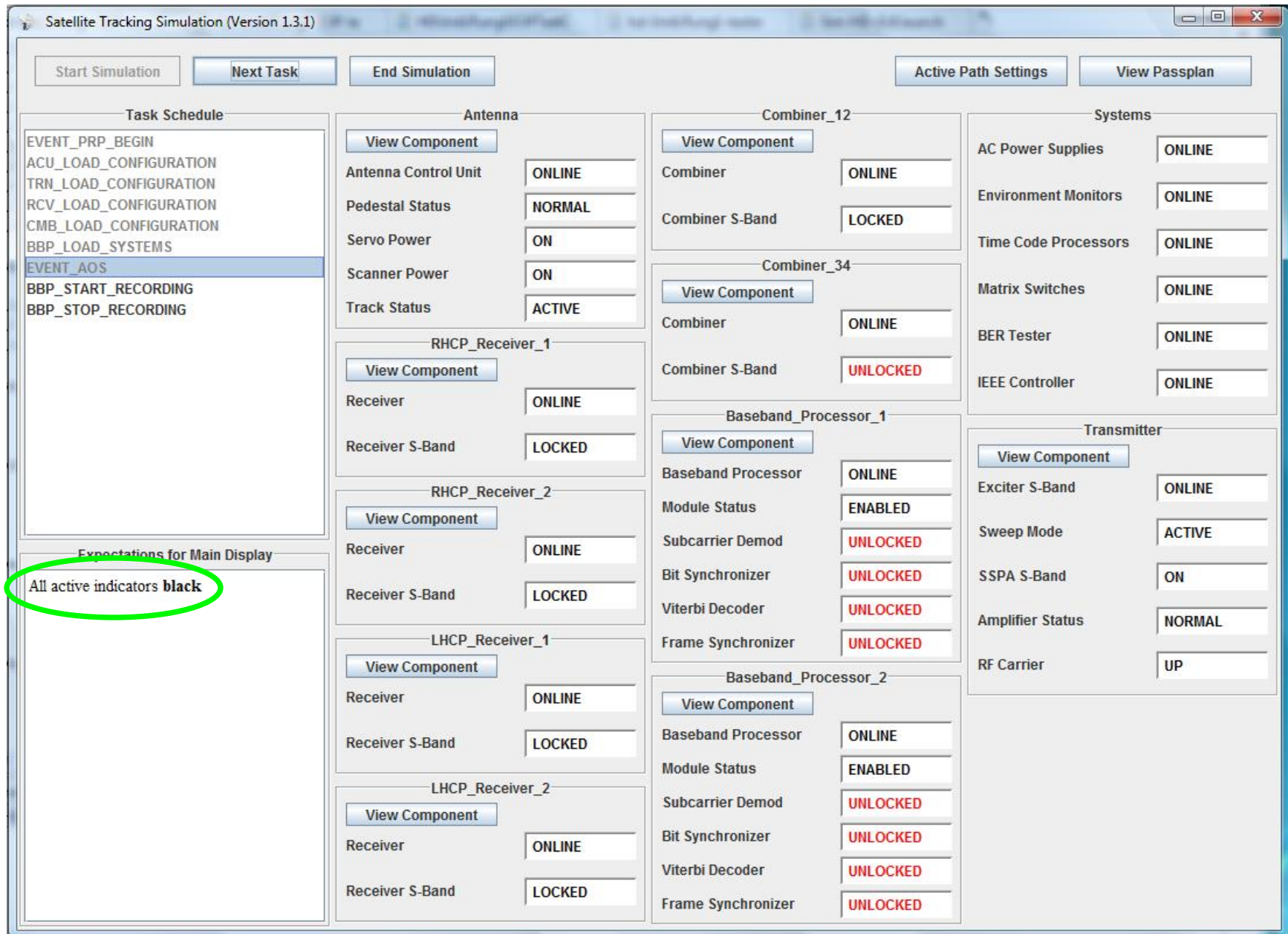
I will provide examples.



Baseband_Processor_1 is an *abnormal* component.



Notice that some of these indicators are **red**.



Notice that the Baseband_Processor_1 indicators are expected to be **black**.

Satellite Tracking Simulation (Version 1.3.1)

Start Simulation Next Task End Simulation Active Path Settings View Passplan

Task Schedule

EVENT_PRP_BEGIN
ACU_LOAD_CONFIGURATION
TRN_LOAD_CONFIGURATION
RCV_LOAD_CONFIGURATION
CMB_LOAD_CONFIGURATION
BBP_LOAD_SYSTEMS
EVENT_AOS
BBP_START_RECORDING
BBP_STOP_RECORDING

Expectations for Main Display

All active indicators **black**

Antenna

View Component

Antenna Control Unit **ONLINE**
Pedestal Status **NORMAL**
Servo Power **ON**
Scanner Power **ON**
Track Status **ON**

View Component

Receiver **ONLINE**
Receiver S-Band **LOCKED**

View Component

Receiver **ONLINE**
Receiver S-Band **LOCKED**

LHCP_Receiver_2

View Component

Receiver **ONLINE**
Receiver S-Band **LOCKED**

Combiner_12

View Component

Combiner **ONLINE**
Combiner S-Band **LOCKED**

Baseband Processor

View Component

Module Status **ENABLED**
Subcarrier Demod **UNLOCKED**
Bit Synchronizer **UNLOCKED**
Viterbi Decoder **UNLOCKED**
Frame Synchronizer **UNLOCKED**

Systems

AC Power Supplies **ONLINE**
Environment Monitors **ONLINE**
Time Code Processors **ONLINE**
Matrix Switches **ONLINE**
BER Tester **ONLINE**
IEEE Controller **ONLINE**

Transmitter

View Component

Exciter S-Band **ONLINE**
Sweep Mode **ACTIVE**
SSPA S-Band **ON**
Amplifier Status **NORMAL**
RF Carrier **UP**

Passplan

Active Path Components

Component Type	Component Name
Antenna	Antenna
Receiver	RHCP_Receiver_1
Receiver	RHCP_Receiver_2
Combiner	Combiner_12
Baseband Processor	Baseband_Processor_1
Decommutator	Decommutator

Control Settings

Component Type	Control	Value
Antenna	Azimuth	200.417
Antenna	Elevation	2.751
Antenna	Program Track Bias	0.000
Antenna	Servo Power	ON
Antenna	Scanner Power	ON
Antenna	Azimuth Bias	0.000
Antenna	Elevation Bias	0.000
Antenna	Track Bias Step	0.250

Notice that Baseband_Processor_1 is on the active path.



We're done with this example.

Example e-student Trace

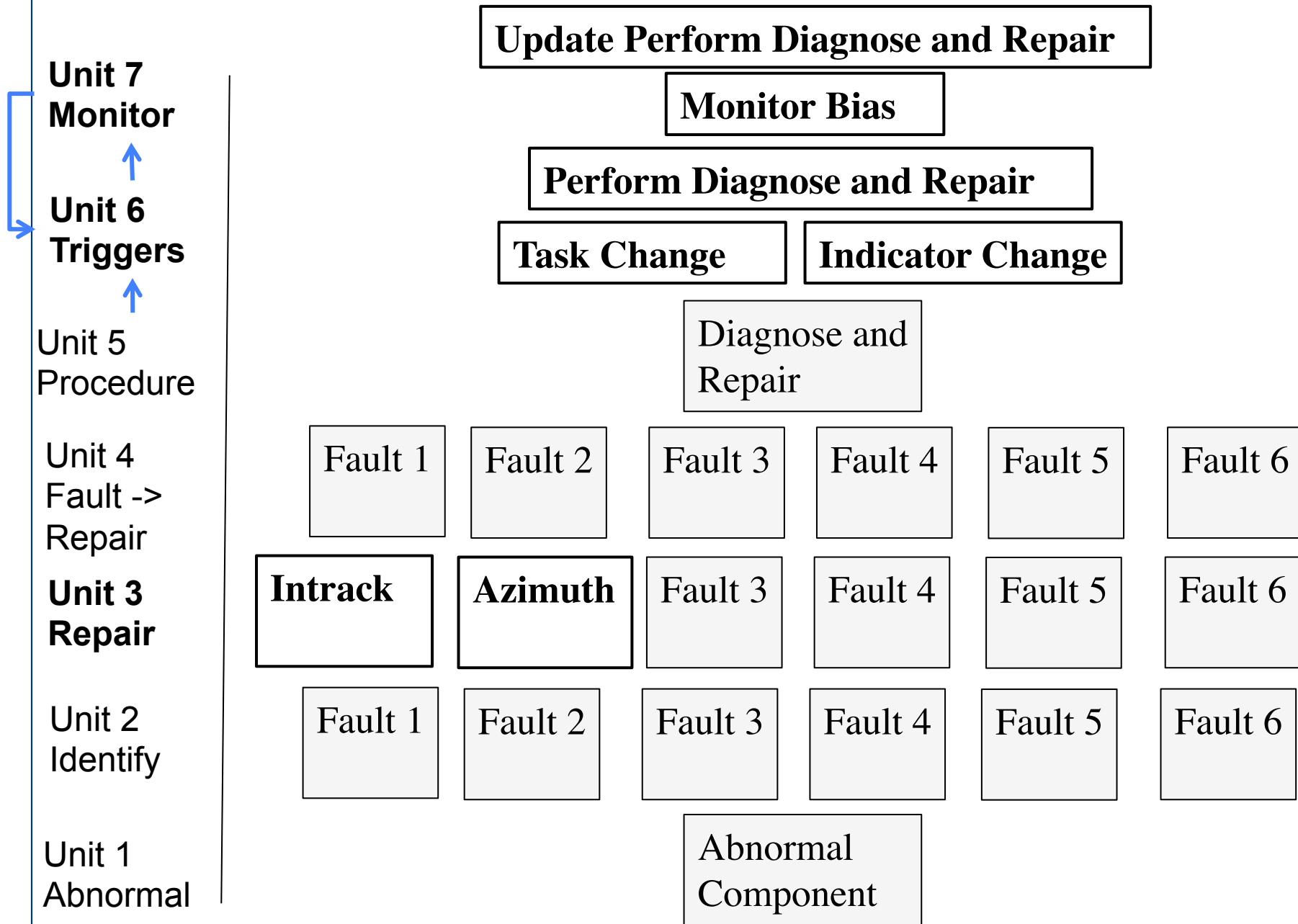
Lesson: HD-Abnormal-CBE-LearningLesson

```
[ Utter(  
  name=Utter-3574,  
  timestamp=Timestamp(system=lesson,offset=379),  
  utterance=LessonTeaches(name=LessonTeaches-3573,arg1=WhenTrue(name=WhenTrue-3572,arg1=Abnormal)),  
  addressee=Student(name=theStudent)) ]  
[ Utter(  
  name=Utter-3591,  
  timestamp=Timestamp(system=lesson,offset=574),utterance=Method(name=Method-3590,arg1=byExample),  
  addressee=Student(name=theStudent)) ]  
[ Imperative(  
  name=Imperative-3635,  
  timestamp=Timestamp(system=lesson,offset=808),  
  request=startSimulation(name=startSimulation-3634,modifiers=[0],faults=["Antenna_Motion_Error"]),  
  addressee=World(name=theWorld)) ]  
[ WorldDone(  
  name=WorldDone-3644,  
  timestamp=Timestamp(system=lesson,offset=1952),imperative=Imperative-3635,source=World(name=theWorld),  
  addressee=Teacher(name=theTeacher)) ]  
[ Perception(  
  name=Perception-3646,  
  timestamp=Timestamp(system=lesson,offset=2025),  
  gainedPercepts=[  
    ComponentConnection(  

```

... for about 70 more pages

Phase III Laddered Curriculum



Performance Results

	Phase II	Phase III
Human	91%	81%
eStudent	100%	100%

Results are not intended for direct comparison:

- Does not include all units
- Does not include injection penalties

Future Work

Significant future work exists in the challenges contained in this curriculum that were tested on humans but not addressed by the e-student:

- Complicated repair procedures
- Analogous repair procedures
- Context-based monitoring
- Concept revision

Acknowledgements

We want to thank our colleagues at BAE Systems, Bester Tracking Systems, Cycorp, Stottler Henke Associates, and University of Texas at Austin for their significant input throughout the curriculum development process: Manfred Bester, David DeAngelis, Robert Grant, Dan Luu, John Mohammed, Dewayne Perry, Benjamin Rode, Howard Reubenstein, Kathy Ryall, and Candy Sidner,

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Questions?