

Situation Awareness and Decision Making

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Outline

- Decisions are necessarily made within some kind of context
 - Can one formalize a context for decision making?
 - Can one formalize the decision making process?
- Situation Theory
 - One approach to a formal treatment of contexts for inference and decision making
- Decision Process Models
 - Several approaches: OODA, JDL, KIDS
- Scenarios
 - Healthcare, Cloud Services, Customer Service, Financial Services

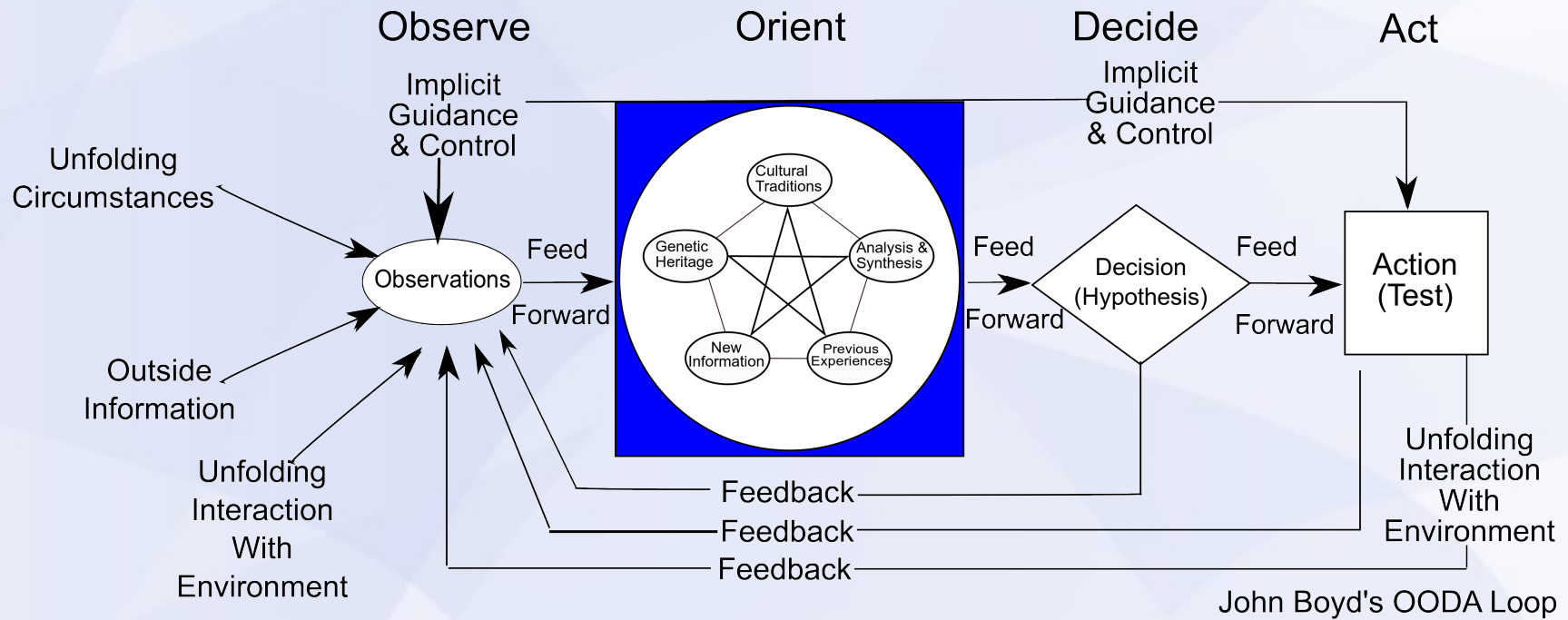
Situation Awareness

- Situation Awareness (SAW) (Endsley)
 - The perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future
- Situation Assessment
 - A process that estimates and updates that state (belief revision)

Formalization of Situation

- Situation Theory of Barwise (1987) and Devlin (1991)
 - Situations are objects that can be part of other situations.
 - The fundamental notion is the *infor*:
If L is a location in a situation s, then L is of type LOC, the infor is $\langle\langle\text{of-type, L, LOC, 1}\rangle\rangle$ and one has $s \models \langle\langle\text{of-type, L, LOC, 1}\rangle\rangle$
- Formulated as the Situation Theory Ontology using OWL in Matheus, Kokar, Baclawski (2003)
 - See www.ccs.neu.edu/home/kenb/STO.owl
 - Inference is implemented with rules which can be logical or probabilistic.
 - Prototype Situation Awareness Assistant implemented STO.

OODA Loop



OODA Loop

- Observe, Orient, Decide, and Act (OODA) Loop
 - Observe the entities and environment,
 - Orient the participant to the observations, by cultural tradition, generic heritage, previous experience, analysis and synthesis, new information
 - Decide on the directives based on the hypotheses that best explains the observations, and
 - Act on the directives to interact with the entities and environment, to test the hypothesis
- Developed by a fighter pilot: Colonel John Boyd
 - Now an important concept in litigation, business and military strategy

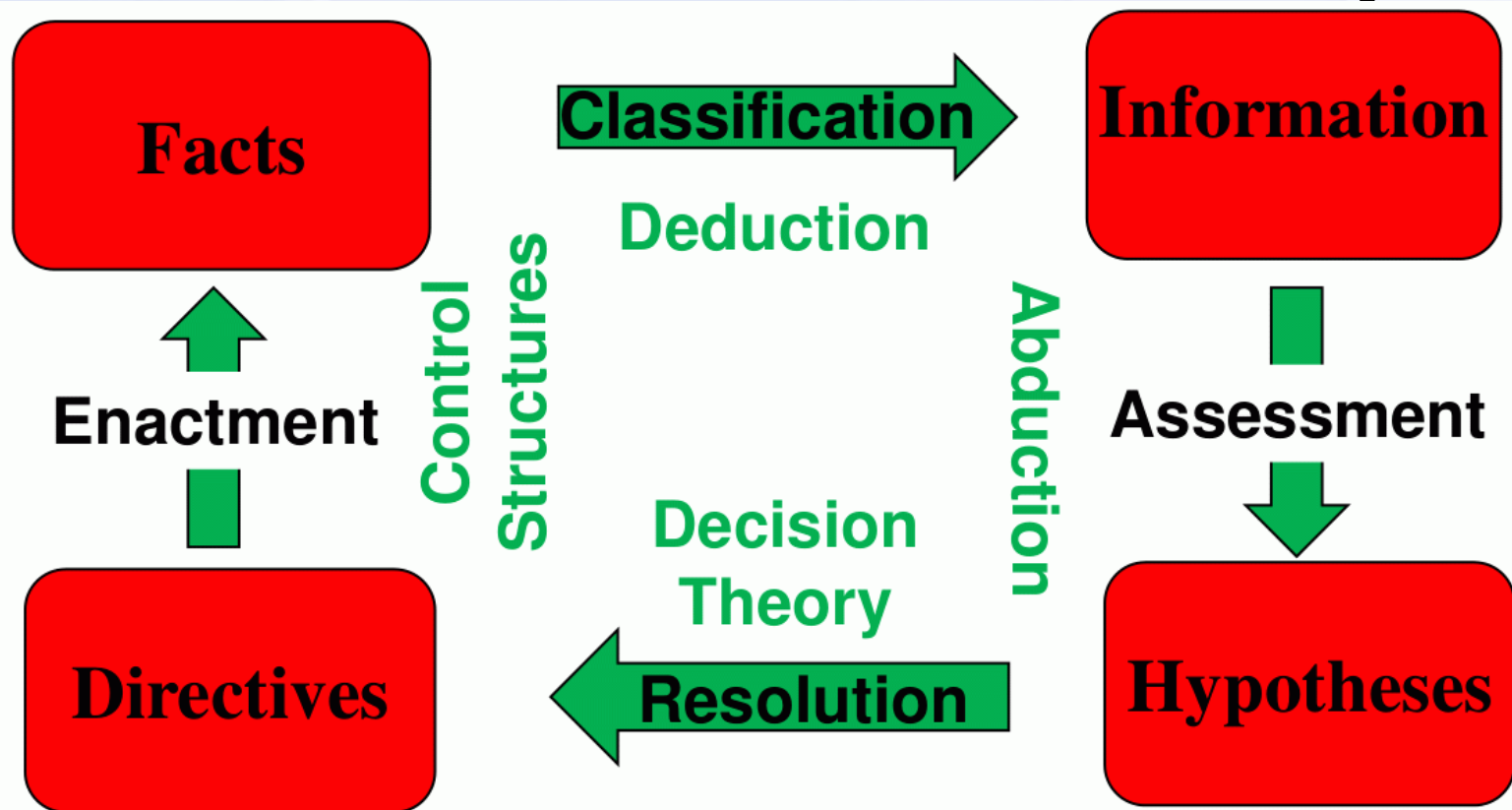
JDL/DFIG Information Fusion

- Another Formalization of Decision Processing
- Organized as a series of levels:
 - Level 0: Sub-Object Assessment
 - Level 1: Object Assessment
 - Level 2: Situation Assessment
 - Level 3: Impact Assessment
 - Level 4: Process Refinement
 - Level 5: User Refinement
- Situation Assessment is central
- Communication takes place between levels rather than as a loop

KIDS

- Knowledge Intensive Data-Processing System
 - Developed by Dieter Gawlick, Adel Ghoneimy, Zhen Hua Liu, Eric Chan, and others at Oracle
 - Formalization of the OODA Loop
 - Designed to be customized with a domain ontology and transformation rules
- References
 - www.cidrdb.org/cidr2015/Papers/15_Abstract43GD.pdf
 - Enabling Enhanced OODA Loop with Modern Information Technology, http://ontolog.cim3.net/cgi-bin/wiki.pl?ConferenceCall_2014_02_13#nid468H
 - Situation Aware Computing for Big Data, Workshop on Semantics for Big Data on the Internet of Things (SemBloT 2014), 2014 IEEE International Conference on Big Data, Oct 27-30, Washington DC.

The KIDS FIHD/CARE Loop



Data

FIHD = Facts, Information, Hypotheses, and Directives

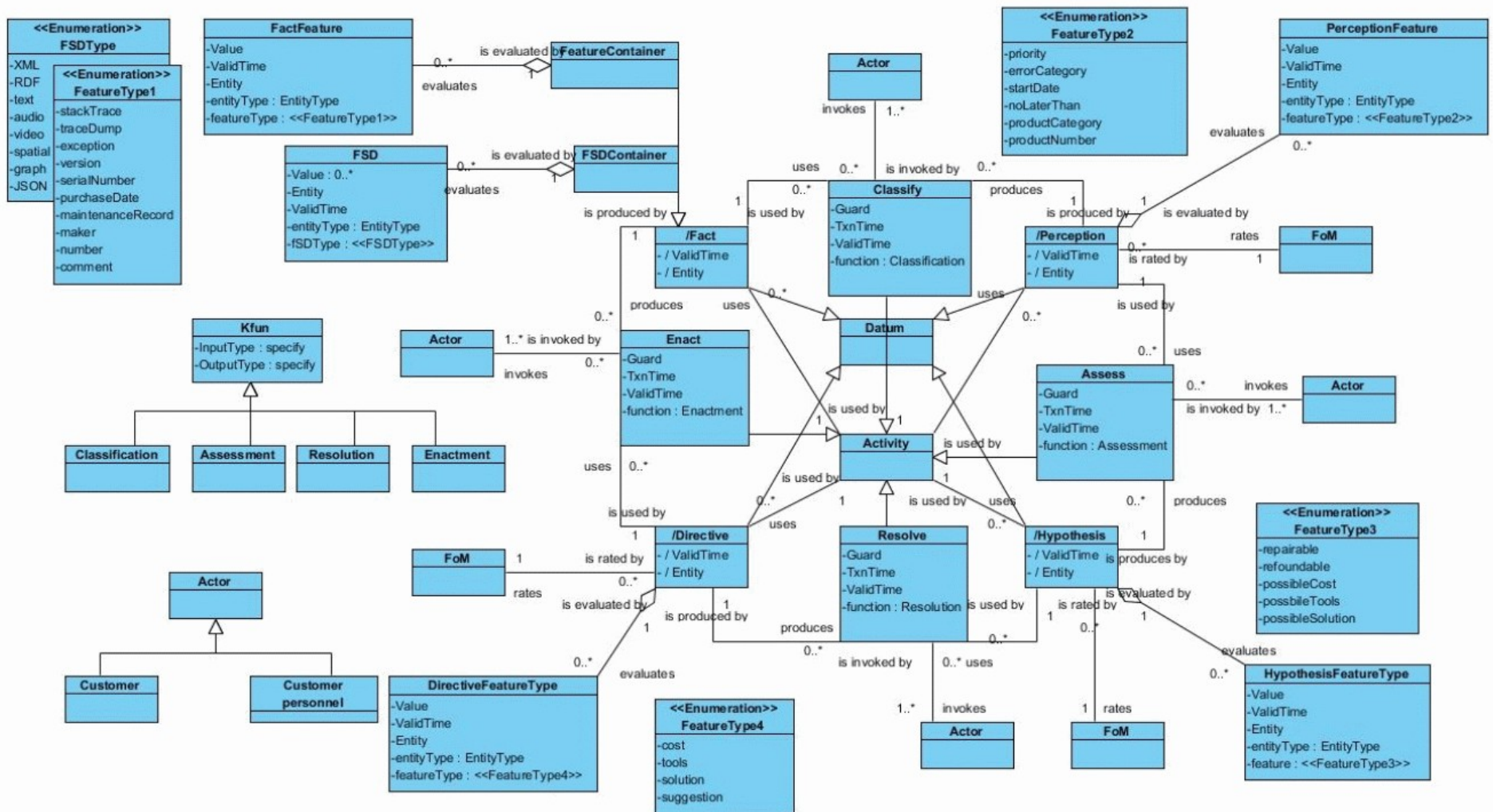
Knowledge

CARE = Classification, Assessment, Resolution, and Enactment

The KIDS FIHD/CARE Loop

- Formalization of the OODA Loop
- Four kinds of data:
 - Fact
 - Information
 - Hypothesis
 - Directive
- Four kinds of behavior (transformations):
 - Classification
 - Assessment
 - Resolution
 - Enactment

KIDS Ontology



Scenarios

- Healthcare
 - Medical Center of the University of Utah
 - Intensive Care Unit data from MIMIC II at MIT
- Cloud Services
 - Rapid response to changing demands for resources
- Customer Service
- Financial Services