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Interactive OODA Processes for Operational Joint Human-Machine Decision Making

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Future CONOPS: Human-Machine Teaming

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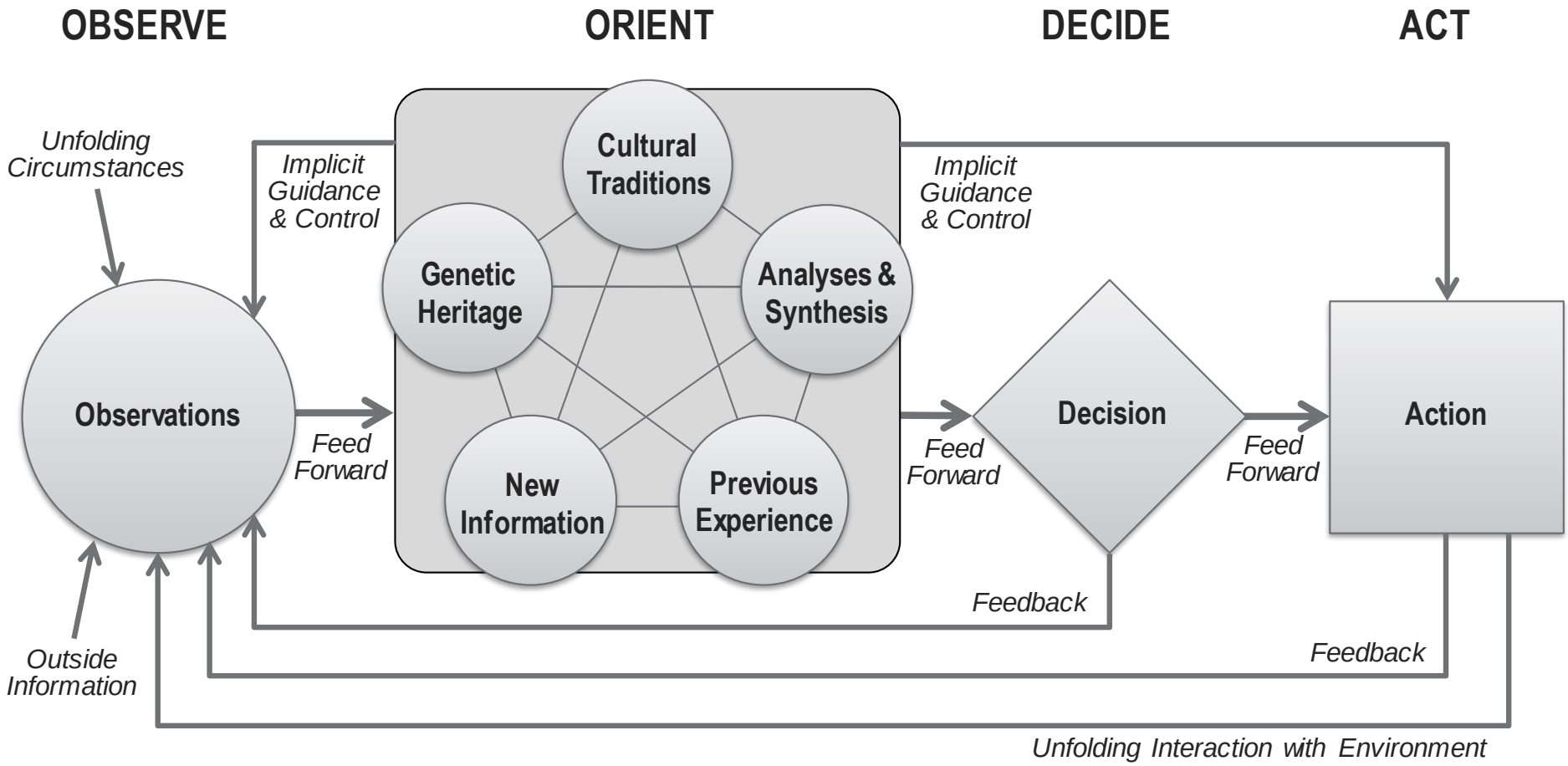
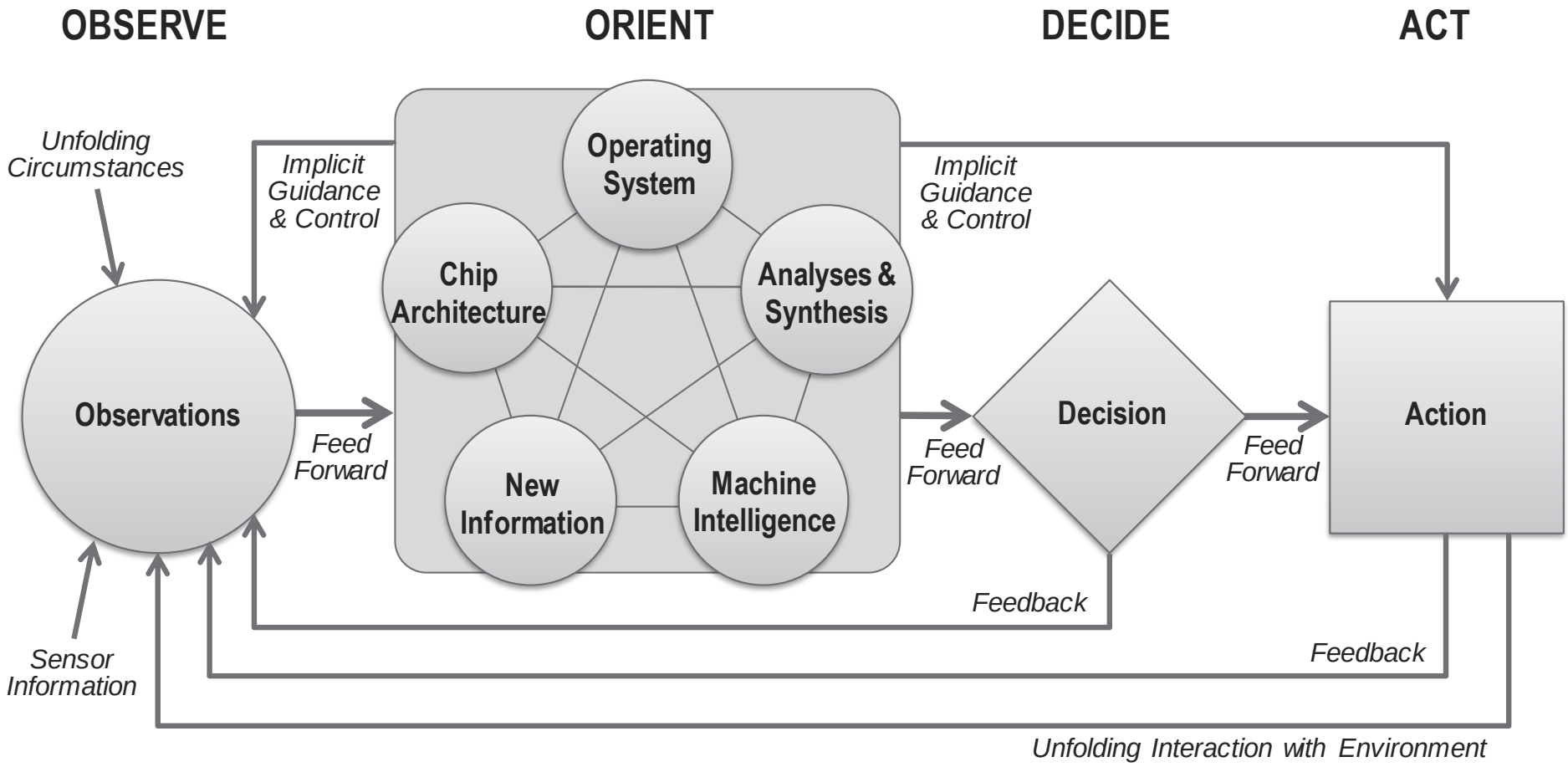
The (Human) OODA Loop



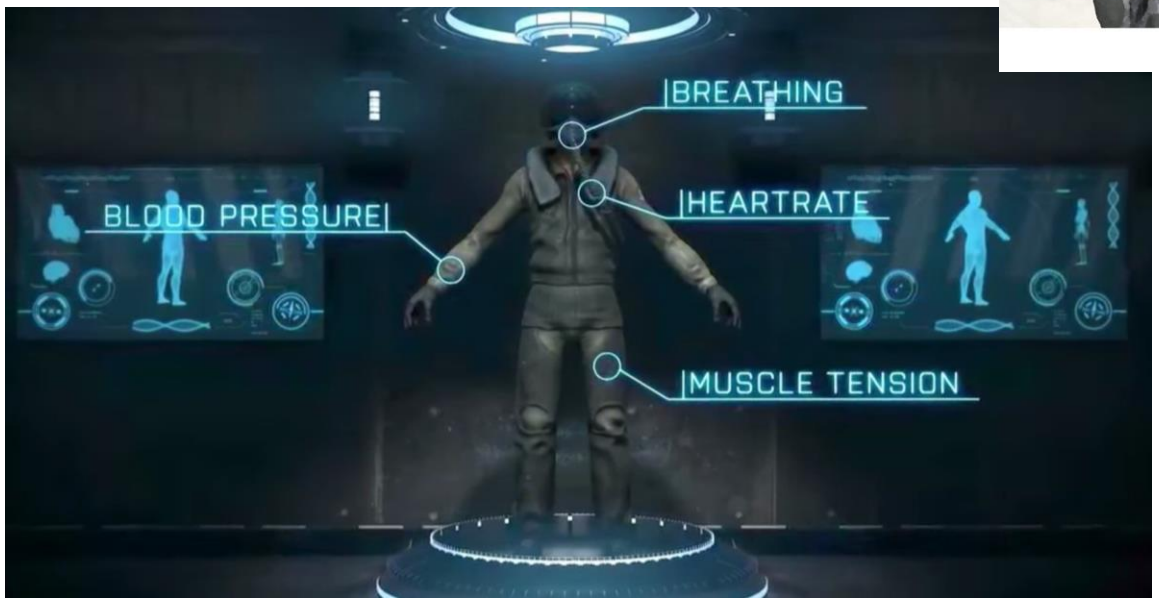
A Machine OODA Loop



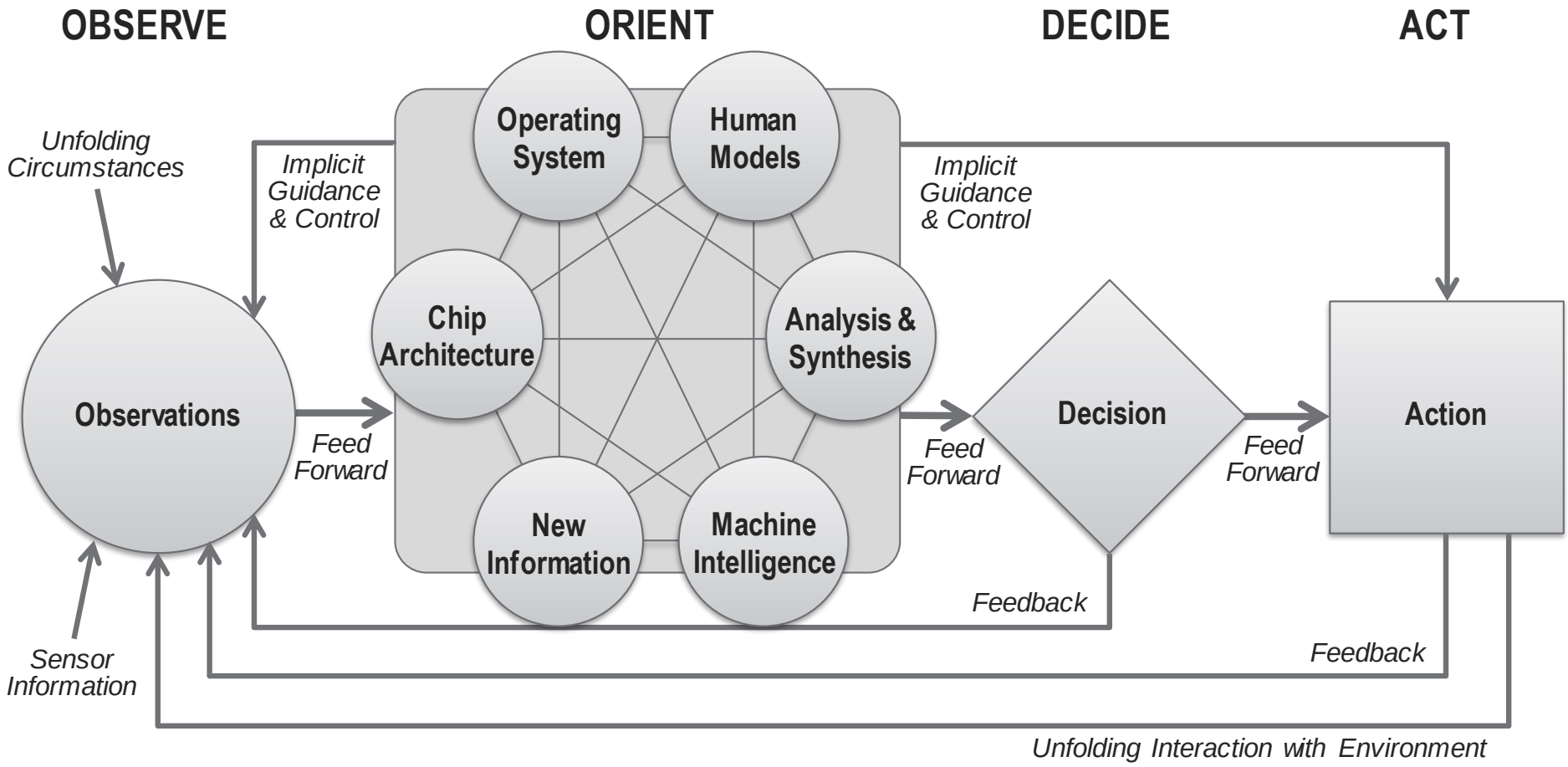
The Machine ORIENT Process

Human	Machine	Implication
Genetic Heritage	Chip Architecture	• Defines physical organization of the processes • Speed-processing capabilities trade-offs
Cultural Traditions	Operating System	• Structure and intercommunications of software • Compatibility • Dictate traditional structures, formats and languages
Analyses & Synthesis	Analyses & Synthesis	• Sensor feeds • Information theoretic in nature
Previous Experience	Machine Intelligence	• Shape memory and knowledge in state space, parameters, ontologies, etc. • Encompasses all possible algorithms
New Information	New Information	• Integration or dependencies across programs/processes • Approaches to parallel processes, distributed computation

Advantaging the Machine OODA Loop



Advantaging the Machine OODA Loop



Now, what does it mean to be out of the loop?

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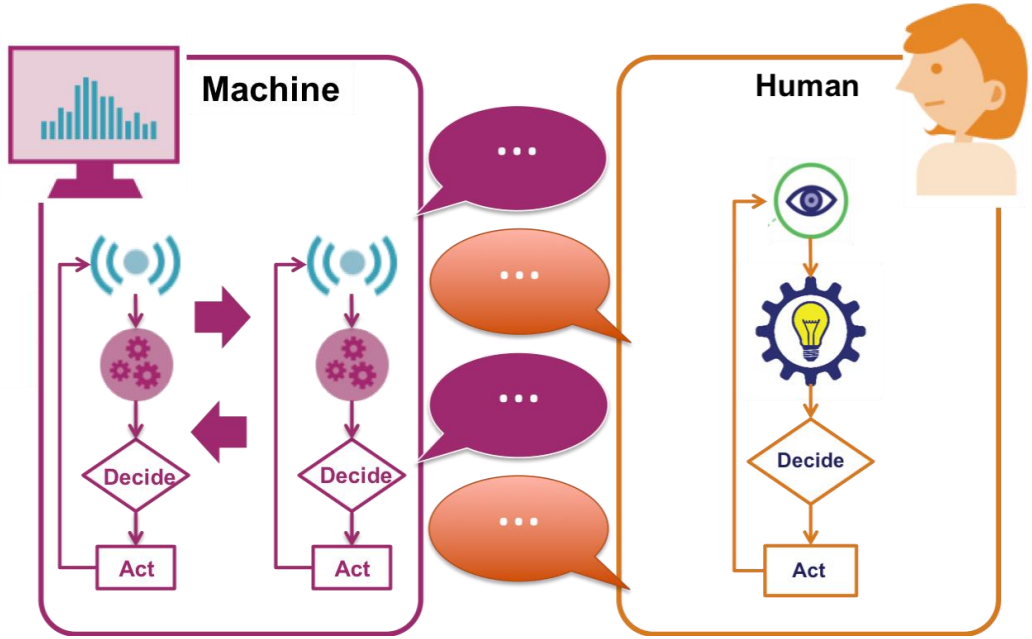
Future CONOPS: Human-Machine Teaming

- Human-Machine Mission CONOPS abstract to interactive human-machine systems as communicating OODA loops



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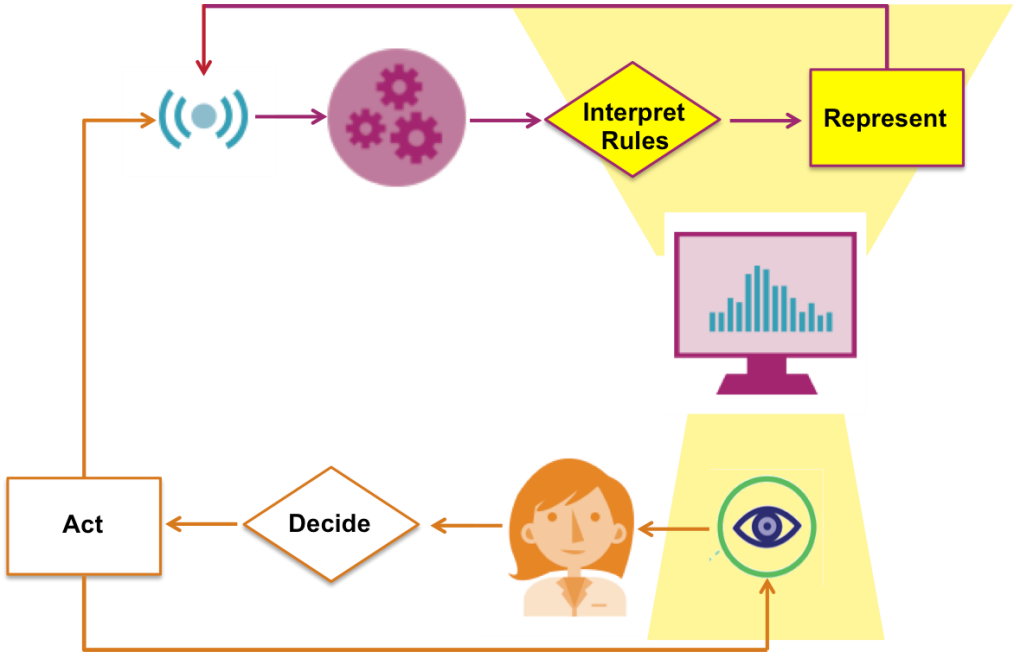
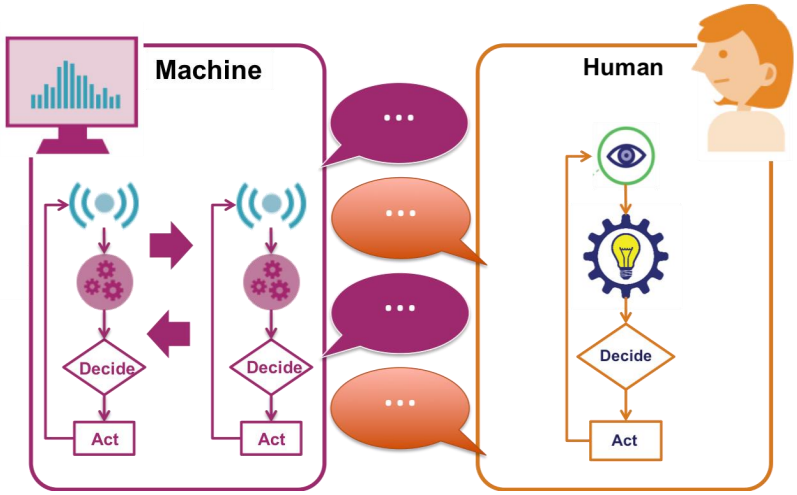
- Human-Machine Mission CONOPS abstract to interactive human-machine systems as communicating OODA loops
- CONOPS for missions dominated by remote machines or created in cyberspace imply human OODA processes entirely mediated by machines.



Joint Intelligence: Communicating OODA Processes



Human-Machine Teams are Concurrent Processes

- Independent Processes
- Common Goal(s)
- Potentially Shared and Separate Tasks
- Noisy Communication Channels
- No Shared Memory
- No Shared Processing Resources
- Different Processing Languages

Simple Human-Machine Team Compositions

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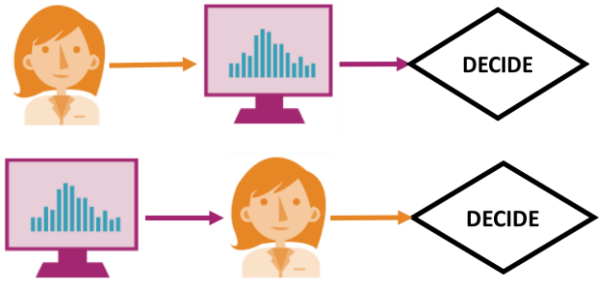
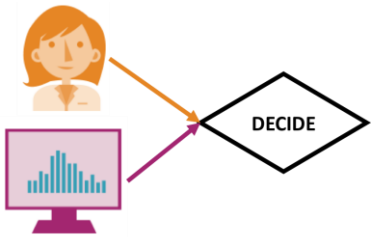
Sequential Composition 	$M \overset{q}{\rightarrow} H \overset{p}{\rightarrow} \mathrm{M}$	• Sequence of events, serial exchange between machine and human processes • "Classical" Human-In-The-Loop	e.g., Power grid control station, Jupyter Notebooks, vending machine
Input/Output Composition 	$H \overset{p}{\rightarrow} \mathrm{M}$ $M \overset{q}{\rightarrow} \mathrm{H}$	• Output of one process is equivalent to the input of the other process • Execution of one waits for input from other • Unidirectional direct communication	e.g., robot vacuum, thermostat e.g., emergency alarm system, heart rate or temperature monitor, fitness monitor
Merge Composition 	$H \mid\mid \mathrm{M}$	• Concurrent processes, start and execute simultaneously • Action of system requires pooling • Can have interleaved communication	e.g., Netflix/Pandora-style recommender systems, mixed-initiative systems for intelligence analysis, Arcade pinball and Donkey Kong

Now, what does it mean to be out of the loop?

Are we designing systems and selecting technology to keep both human and machine in the loop in the right way?

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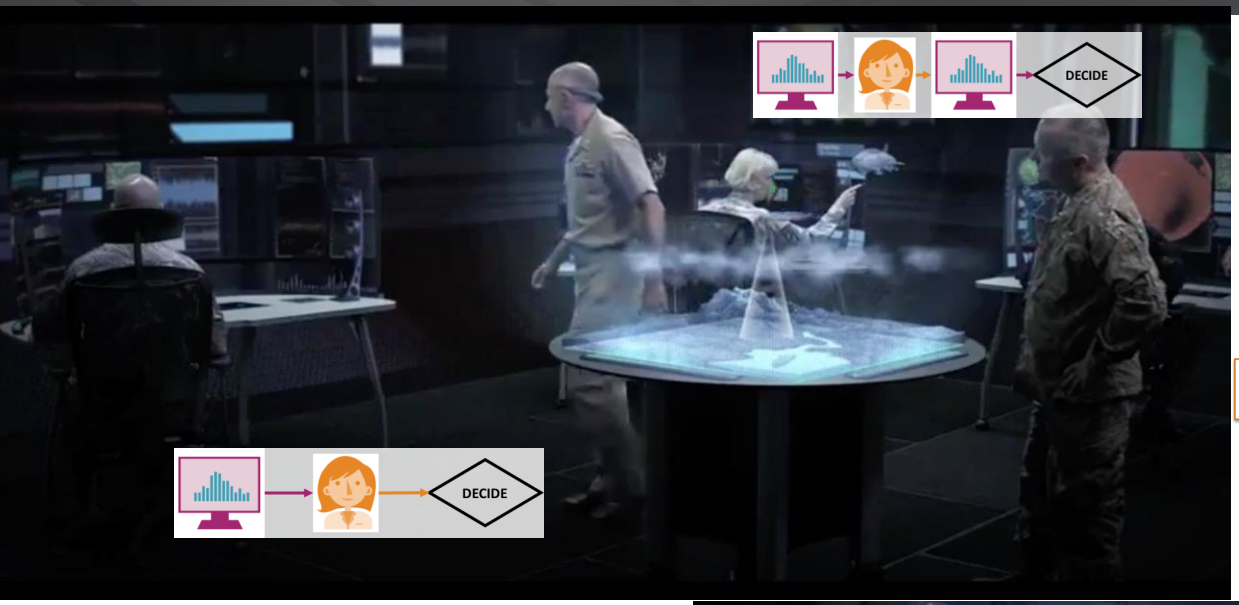

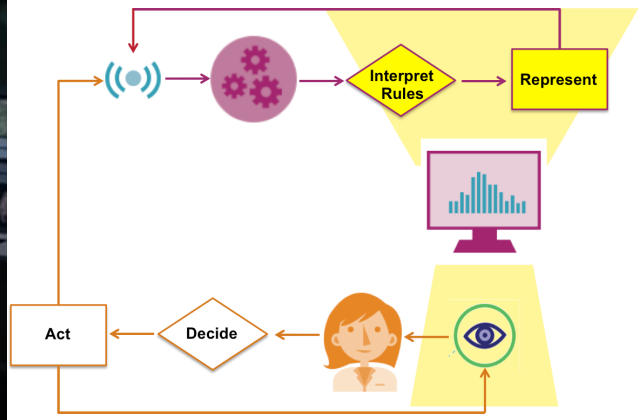

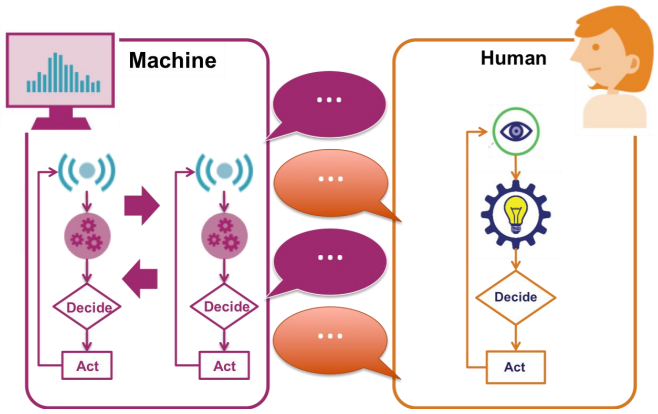

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