Robot^iQK

Prototyping the Future
^Together for All Ages

Educational Robotics & Digital Technologies for Computational Thinking
for Resource-Limited Communities

Robot^iQK: Summer Robotics 2019

Welcome

Dr. John-Thones Amenyo
Department of Mathematics & Computer Science
York College, CUNY

Contact: (718) 262-5358 Email: robotiq@york.cuny.edu Office: AC-2C07

RobotiQK

PROTOTYPING THE FUTURE Together AT ALL AGES

York College Summer Robotics Program 2019

| Take Apart | Build, Construct, Innovate | Program, Code | Use, Explore | Apply in Real World Challenges & Problems

July 8 – August 2, 2019: Monday-Friday: 1 pm to 4 pm

Immersion Program in Robotics, Drones & AI for STEM+Arts* for Grade 6 – Grade 12 Students

A Service from York College & CUNY to the Jamaica, Queens, NYC Community

Free

www.york.cuny.edu/robotiqK Or www.york.cuny.edu/robotiq

MANDATORY ORIENTATION MEETING: July 1, 2019, in AC 3D01, 6 pm – 8:00 pm.

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(2019)

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Orientation Meeting Schedule

Welcome

York College Summer Robotics Program

History

Logistics

Demos: Preview of things to come

Tactics & Mechanics

Recap & Summary

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Summer Robotics Program

RobotiQK: York College Summer Robotics Program

Who:	**K6-K12 (Middle School to High School Students)**
	Undergraduate Assistant Instructors (12 + 1)
Where:	**Jamaica, Queens, New York City, USA**
When:	**Summer 2018 (120 + 12), Summer 2019 (250 + 15)**
What:	**Use Educational Robotics to Foster STEM+ Learning**
What:	**Use Ed. Robots for Computational Thinking & CS4ALL**
How:	**Students Program Robots + Drones: Use Visual Programming**
How:	**US Department of Education (DOE) Funded**
How:	**Managed by Office of the Provost, Dr. Panayiotis Meleties**
Why:	**K-12 to Prototype and Understand the Coming New Disruptive World of AI, Algorithms, Machine Learning, Big Data, Cloud Technology, Digital Automation. Computational Thinking**

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Logistics

Summer 2019 Program: July 8 – Aug 2, Mon – Fri, 1pm - 4pm

2 x 2-Week Sessions:

Session 1: July 8 – July 19; Demo Day SI: July 18, 2019

Session 2: July 22 – Aug 2; Demo Day SII: Aug 1, 2019

Please Attend Only the Session Assigned To

There is NO Switching of Sessions. CANNOT Attend Both Sessions

Complete Attendance is Mandatory and Required Everyday.

Punctuality is Very Important: Drop Off & Pick Up

Visitor Courtesy Parking is Available

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Logistics

Emergency: Go to or Contact Campus Public Safety 718.262.2222 Rm AC-1M02
Students CANNOT Wander Off Around the Building or Campus
Students CANNOT Play "Tag" etc. in the Building or on the Premises, esp. Steps
Student SAFETY and SECURITY is of Greatest Concern
Acceptance: Application must be filled and Signed by Parent or Guardian
*****Parents CANNOT Disrupt Activities-in-Progress in order to take Student Out for Various Reasons. It is Grounds for Automatic & Immediate Withdrawal from the Program. NO EXCEPTIONS**
Student Supplies: Notebook / Lab Notebook | Markers | Pen | Drawing Set | Dictionary, Thesaurus. Optional: Phone, Laptop/Notebook, Tablet

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Assistant Coach Team

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Summer Robotics Program 2018

***About 12 – 15 different types of (Educational) Robots and Drones**

***Visual Programming of the Robots and Drones Using Scratch and variants (Block Coding) (Can Teach Scratch to anyone 5yrs-100yrs!)**

***STEM Explorations using Modular Electronics Kits**

***Highlights: Demo Day: Students Exhibit Achievements to Families, College Community, Local Community. mini Research Project Reports.**

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Demos: Preview of things to come

Demos

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Feedback

Questions
Comments
Critiques
Suggestions
Recommendations

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Summer Robotics Program

More than 15 different types of (Educational) Robots, Drones, STEM Kits

Lego Mindstorm EV3
Vex IQ, Vex SuperKit,Vex Prog Stat
CoDrone Pro
Sphero Sprk+, Sphero Mini, Sphero BOLT
(Makeblock) MB Codey Rocky
MB AirBlock drone
MB Neuron
MB mBot Ranger
Littlebits Rule Room, Gizmos & Gadgets, Star Wars Droids
DJI Ryze Tello EDU drone
Microduino Itty Bitty Buggy
EZ-Robot JD Humanoid Robot
Edison V2.0 robot

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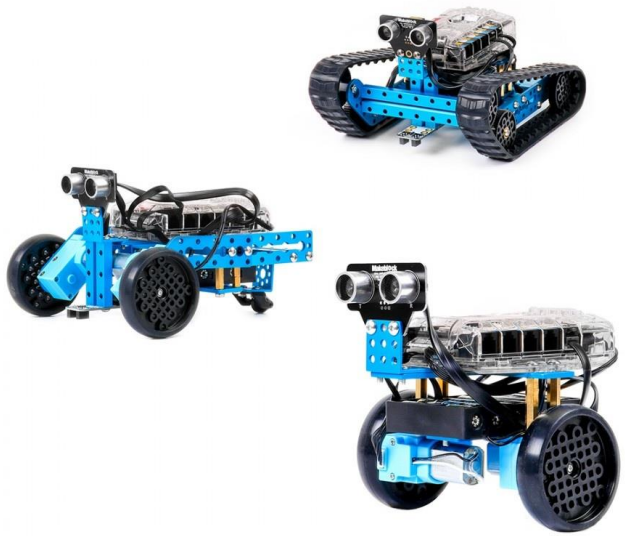

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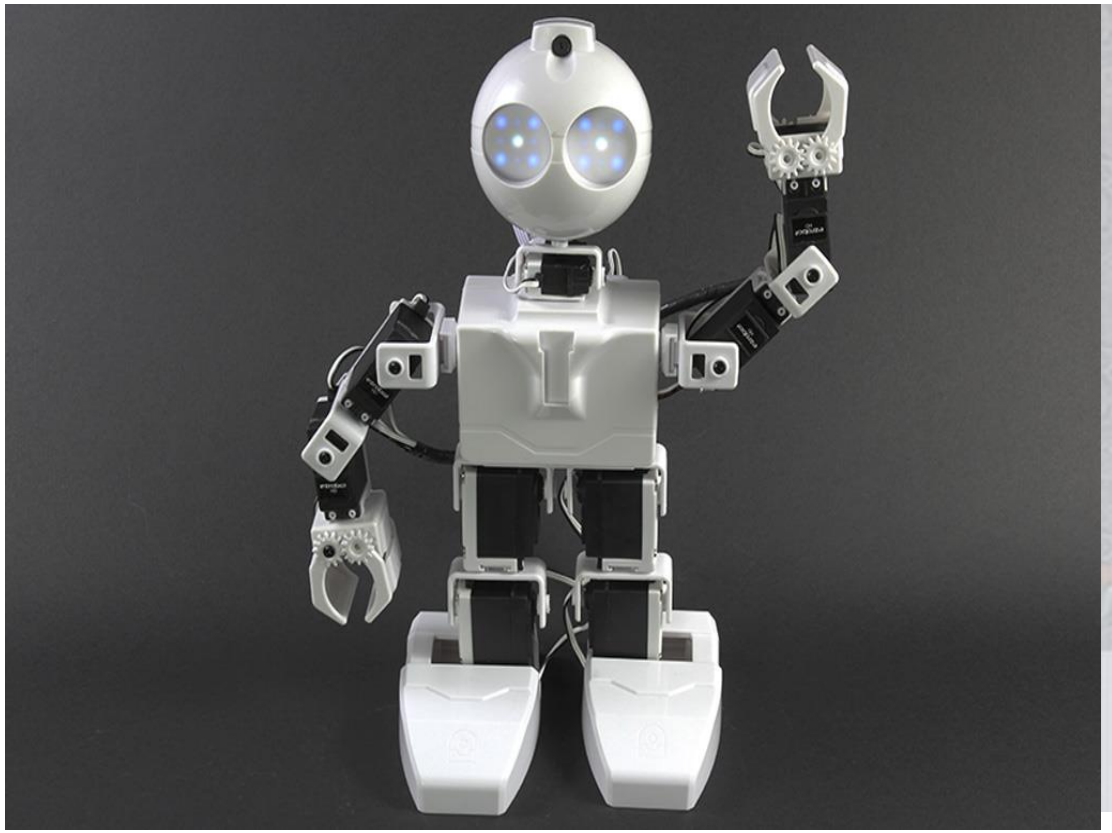
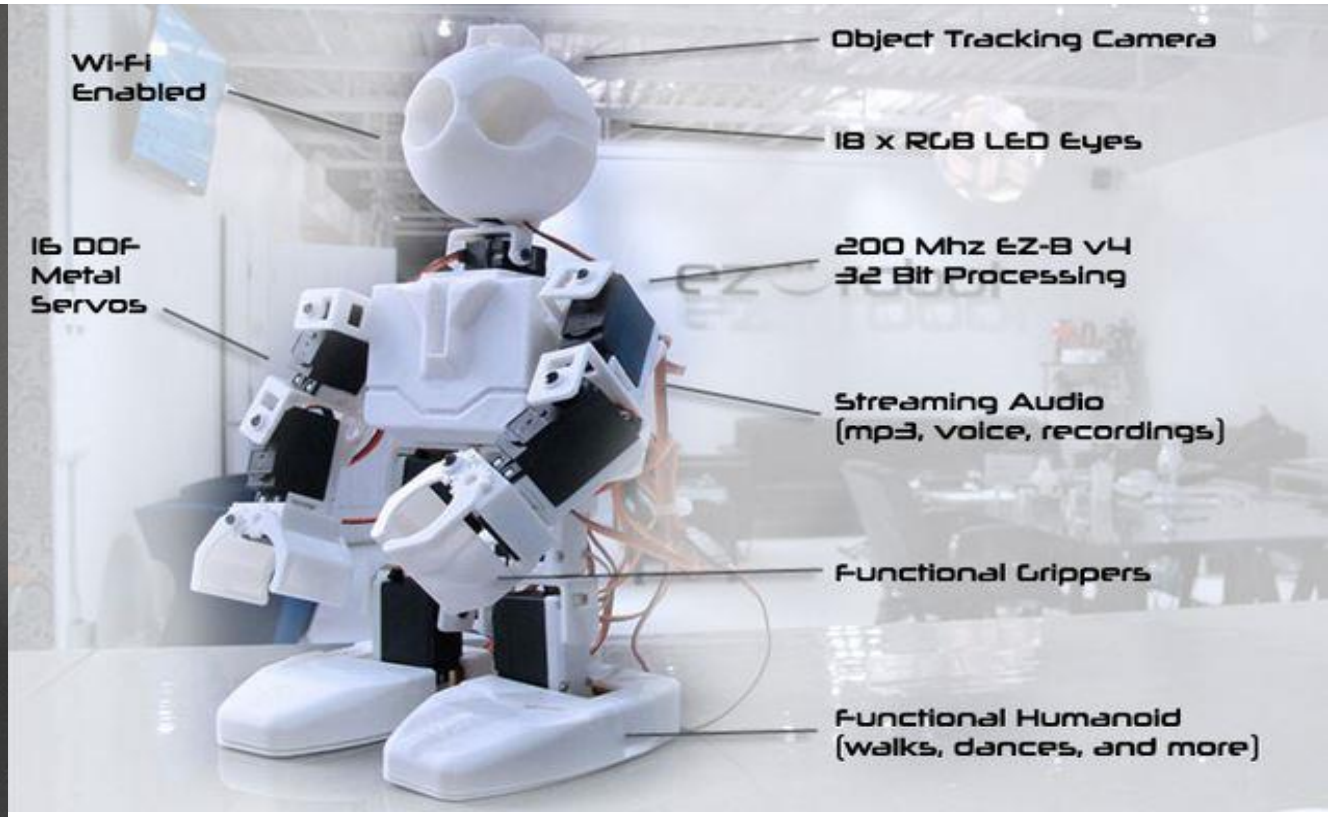
More than 15 different types of (Educational) Robots, Drones, STEM Kits





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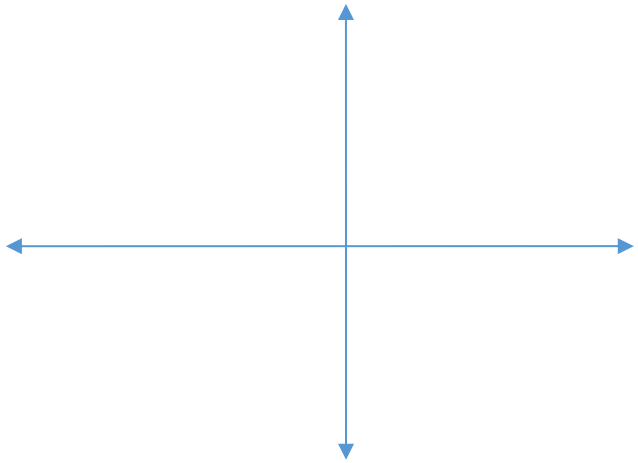
Tactics & Mechanics

Compete

Create



Explore

Collaborate

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Tactics & Mechanics

Compete
Contest
Conflict
Contention

Create
BUILD
Generate
Update
Improve
Enhance
Optimize
Augment
CRUD

Explore
Analyze, Apply
Utilize,
Consider
Discover

Collaborate
Cooperate
Unite, Union
Confederate

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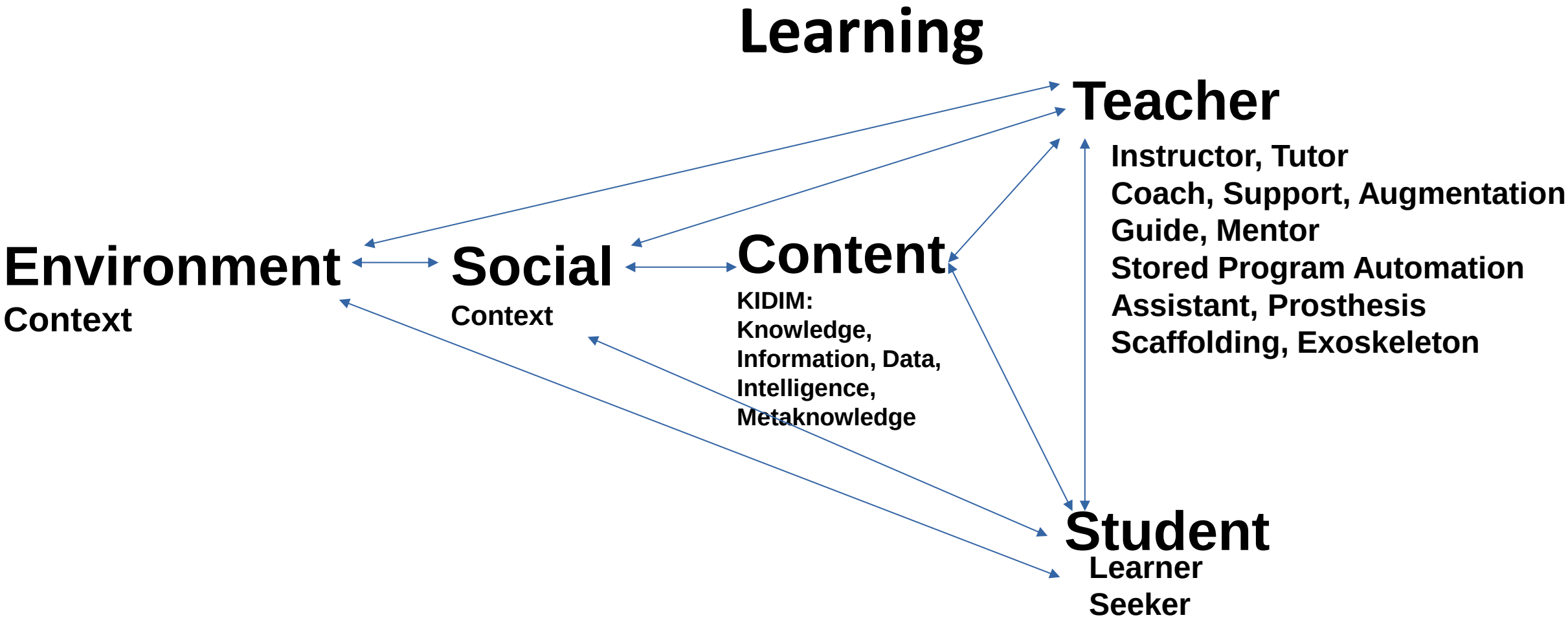

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Learning: Schemas, Models

A.Bandura

- Motivation
- Attention
- Retention
- Reproduction

B.J. Fogg, N.Eyal

- Motivation
- Ability
- Trigger
- Action
- Behavior
- Outcome
- Results
- Influence
- Costs
- Awards

M. Levine

- Attention Control System
- Memory System
- Language System
- Spatial & Sequential Ordering
- Motor System
- Higher Thinking System
- Social Thinking System

X?

- Acquire Knowledge
- Solve Problems
- Make Decisions
- Transactions

"**Children Learn Best by Doing What They Enjoy**" *(attributed to:John Dewey)*

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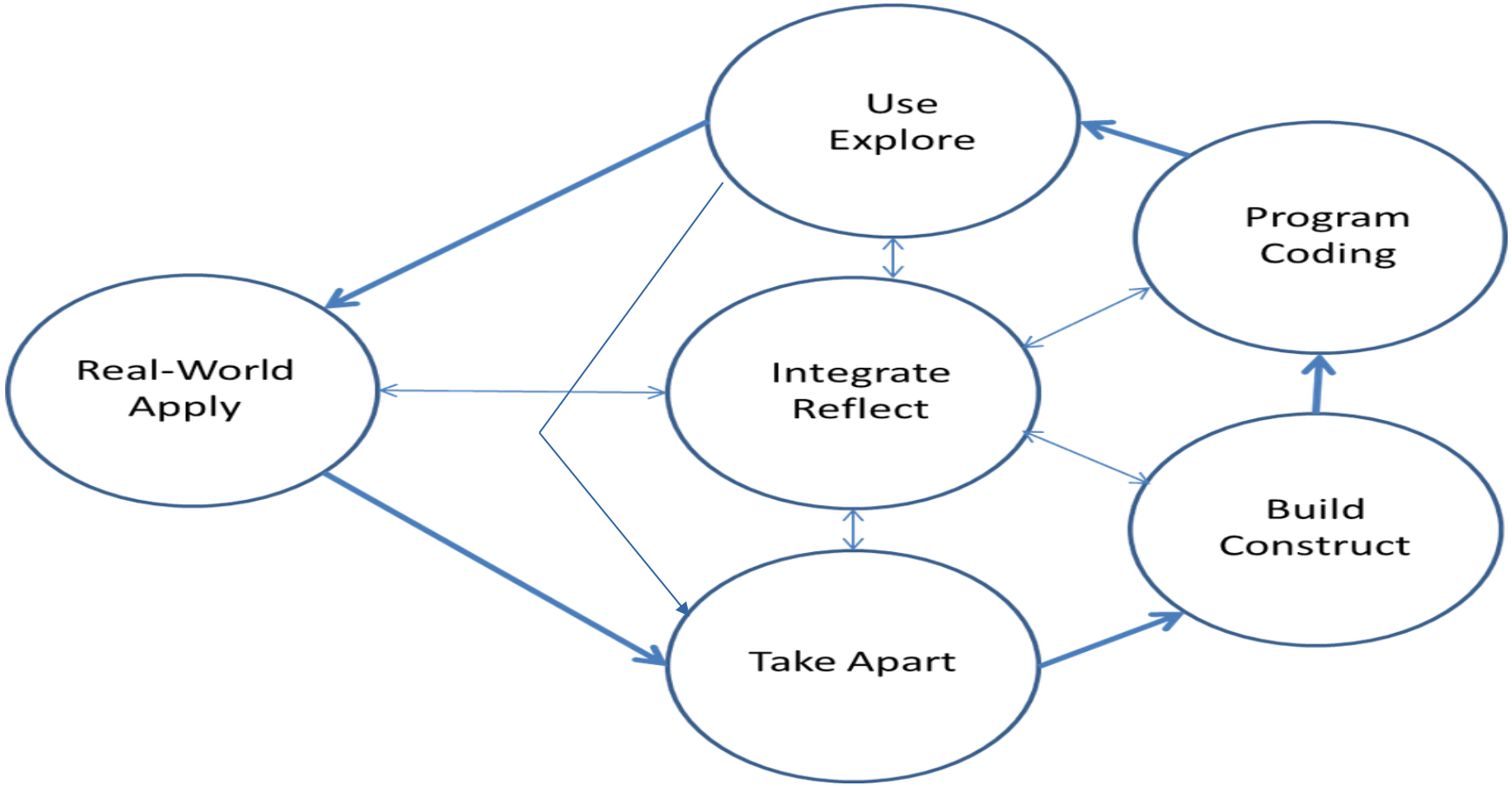
Tactics & Mechanics



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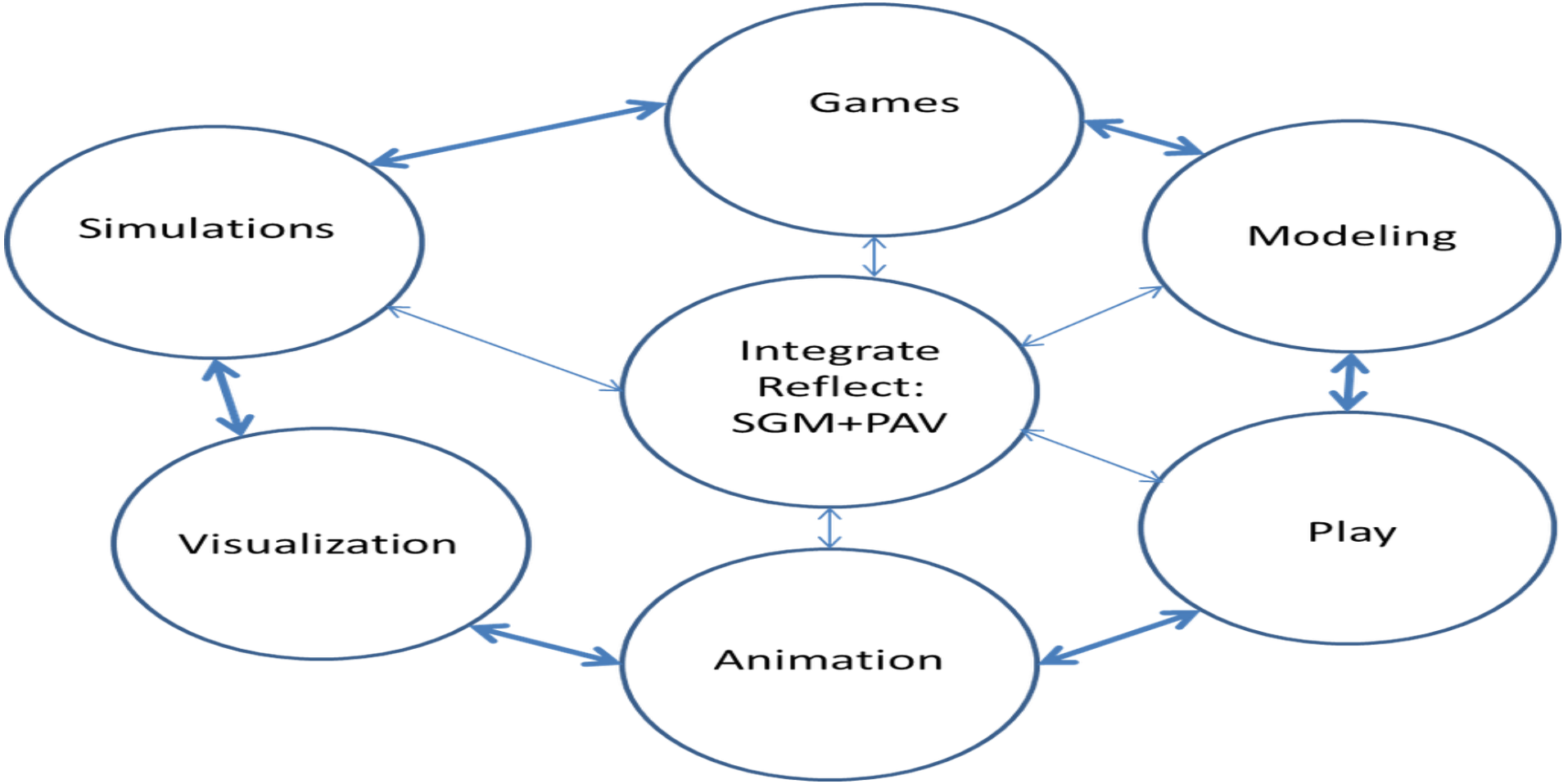
Tactics & Mechanics



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Session Work Schedule, Work Plan (Adaptable)

Day 1	Start	Play Explore Experience Discover	
Day 3	Program	Explore. Build Explore	
Day 4	Build	Program Explore	
Day 5	Choose Project	Build Program Explore	
Day 6	Choose Project	Build Program Explore	
Day 7	Choose Project	Build Program Explore	
Day 8	Program	Explore. Prep for Demo Day	
Day 9	Demo Day		
Day 10	Final Day	Recap	

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Programming with Scratch

Developed at MIT Media Labs

Assemble Computer Programs, Software

Use Lego-like Building Blocks Modules

Teach Anyone How to Program & Code

Including 4yr – 5yr olds & Above (All Ages)

ANYBODY Can Program!!!

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Digital Technology in Social Context

Future of Work, Jobs, Employment, Careers, Professions
Digital Technology
Automation
AI
Algorithms
Autonomics
Machine Learning
Computational Thinking

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Theoretical Framework: Digital Technology

Transformations, Transitions, Trends, Impacts: Disruptive, Opportunities, Threats
Future-of-X: Question Everything!!! Re-Imagine Everything!!! Creative Destruction (Schumpeter)

Personal (Implantable, Wearable, Hearable), (Food, Diet, Nutrition, Exercise, Sleep, Health, Medicine, Healthcare, Lifestyle, "LifeStreams", Quantified Self, Self-Actualization, Work, Jobs, Employment, Career, Profession, Trade), Family, Household, Residential, Community, Town, City, Municipality, State, Province, Nation, Country, International, Global, Worldwide, Social, Society, Cultural, Economic, Industrial, Commercial Religious, Environmental, Ecological (Water, Climate, Energy, Fuel, Waste, Pollution, Deep Sea), Space, Future of Work, Automation, IOT, "Mirror Worlds"

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Digital Technology: Computational STEM+: Age of Algorithms

"I've noticed an interesting trend. Pick any field X, from archaeology to zoology. There either is now a "computational X" or there soon will be. And it's widely viewed as the future of the field." (S. Wolfram, 2016)

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Mechanics: Thinking: Scientific | Engineering | Mathematical | Other

Computational Thinking, Integration, Systems Thinking, Design Thinking, Disruptive, Re-Imagined, Creative Destruction, Re-Engineering Thinking, Self-*, Autonomic Thinking, Engineering, Terra-forming Thinking, Visual Thinking, Reflection, Practice, Prototyping, Meta-Cognition, Scenario, Case-Based Thinking, Multiple Intelligences

Analytic Thinking, Synthetic Thinking, Logic Thinking

Cope with: Volume, Scale, Variety, Diversity, Complexity, Multi-Scale, Order, Hierarchy, Velocity, Veracity, Efficiency, Change, Evolution, Adaptation, Migration, Variation, Continuous Total Quality Improvement

Approaches: Simulations + Games + Models + Play + Animations + Visualizations + Prototyping + Storytelling+Ideation (Generation.Of.Diversity (G.O.D) → Compare, Grade, Optimize → Selection)+ Augmentation + Prosthesis + Exoskeleton

Other Modes of Thinking, Approaches: Analytical,Empirical, Experimental, Statistical, In Silico, Simulation, Reductionist

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Project-Driven, Problem-Solving Orientation
Goal-Based, Deliberative, Intentional, Purposive

Adventure, Journey, Hero's Journey, Heuristics, Game-like: Design & Play

Logistics

Mechanics
Dynamics

(Ref:G. Polya, I. Lakatos, J. Campbell, J McGonigal, N. Lazzaro R. Bartle)

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Mechanics:

Resources, Assets:

Robots (Educational Robotics)

Drones, UAVs, Quad-copters, Hexa-copters (Programmable)

Hardware (HW): Smartphones, Tablets, Laptop & Desktop PCs

OS (MW): MS Windows, Google Android, Apple IOS

Software (SW): Scratch + variants: Visual Programming, Block Coding, Python, Javascript, C++, C

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Robot Programming-in-Context:

SW: Applications, Services
SW: Middleware (MW)
SW: OS
SW: Firmware
HW

Web	Mobile	Internet	Server	Embedded
Desktop	Portable	Cloud	Grid	Implantable
Laptop	Smartphone	IOT	Supercomputer	Brain-Compter Intf
	Tablet	MSP: Multi-Sided Platform	Cloud	IOT
	Wearable			Wearable
	Hearable			Hearable

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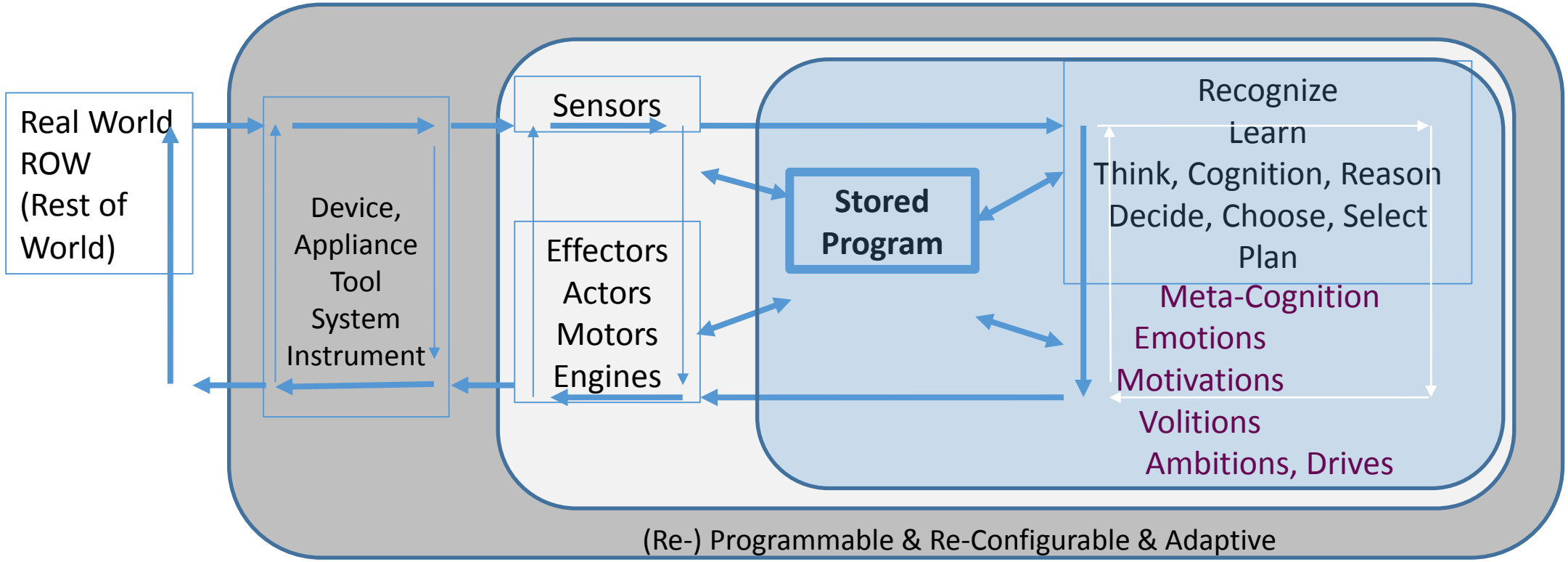
Reactive & Cybernetic & Intelligent Agent Model



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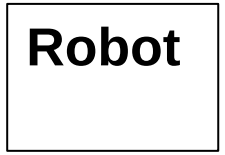
Robot



Robot: Smart, Intelligent System Device, Appliance, Artifact, Instrument, Equipment, Machine, Tool, Facility, Plant, Process Plant, Factory, Manufactory, Vehicle, Automobile, Craft, Aircraft, Spacecraft, Planetary Rovercraft, Watercraft, Submarine craft Agent, Bot, Actor, Process, Server, Intelligent Assistant, Intelligent Cognitive Assistant, Sensor, IOT device

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Robot-in-Context

Environment: Surroundings, Ambience, Medium, Matrix, Immersive Space-Time-Matter, Physical: (Physics, Chemistry, Biology, Biotic, Psychological, Mental, Social, Ecological)

Robot: **Smart, Intelligent System** Device, Appliance, Artifact, Instrument, Equipment, Machine, Tool, Facility, Plant, Process Plant, Factory, Manufactory, Vehicle, Automobile, Craft, Aircraft, Spacecraft, Planetary Rovercraft, Watercraft, Submarine craft

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Robot-in-Context

Environment – Robot Interactions:

Communication, Exchange, Inter-linking, Interconnection, Inter-coupling,

Robot: Smart, Intelligent System Device, Appliance, Artifact, Instrument, Equipment, Machine, Tool, Facility, Plant, Process Plant, Factory, Manufactory, Vehicle, Automobile, Craft, Aircraft, Spacecraft, Planetary Rovercraft, Watercraft, Submarine craft

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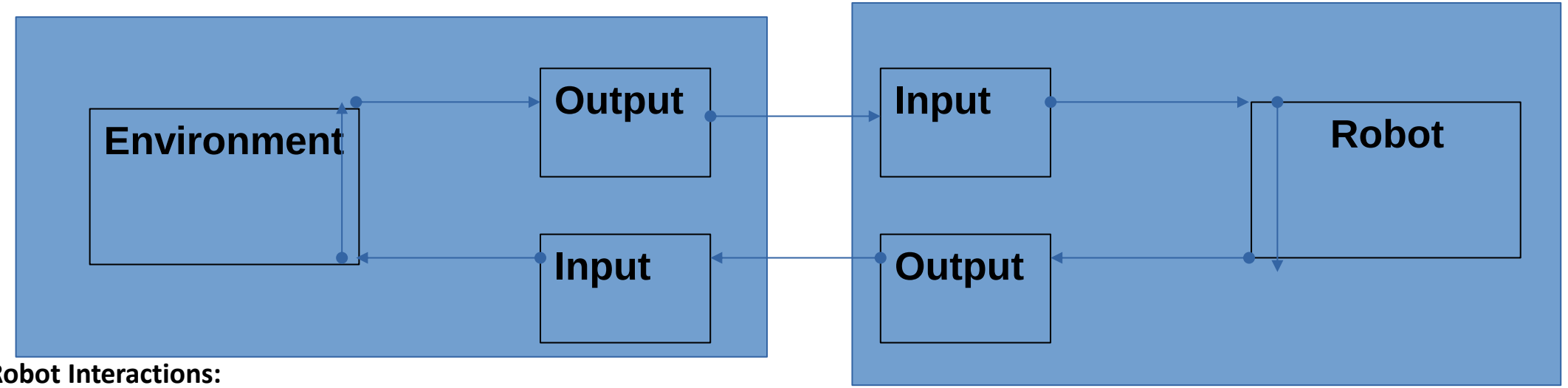
Robot-in-Context:



Environment – Robot Interactions:

Communication, Exchange, Inter-linking, Interconnection, Inter-coupling, Interfacing, Inter-coordination

Interaction Models, Schemas, Patterns:

PMSCIO: Processor-Memory-Swtching (Communication)-Control-IO

MVC: Model-View-Control

PDCA: Plan-Do-Check-Analyze; or CAPD: Check-Analyze-Plan-Do
(Ref: W.E. Deming)

Sense-Analyze-Solve-Do Cybernetics Cycle
(Ref: N. Wiener, C.E. Shannon)

EDC/FT: Emergency-Disaster-Crisis.Catastrophe/ Fault Tolerance

CTQI: Continuous-Total-Quality-Improvement

Evolution Life Cycle Adaptation: EDD Design-Reengineering-MRO-UTM-CRUD-ITD-OCA-OAU

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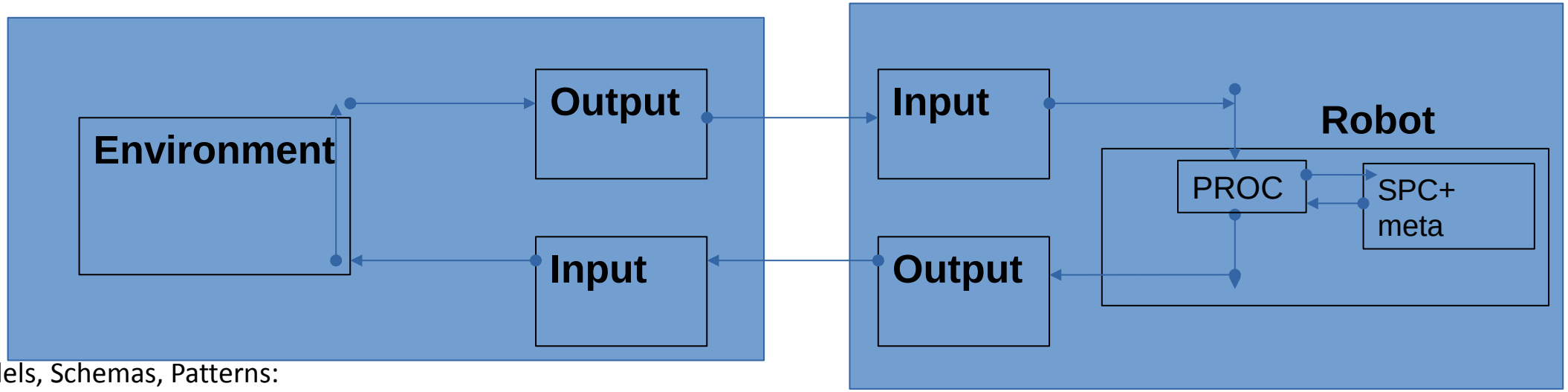
Robot-in-Context:



Interaction Models, Schemas, Patterns:

PMSCIO: Processor-Memory-Swtching (Communication)-Control-IO

PDCA: Plan-Do-Check-Analyze,; or CAPD: Check-Analyze-Plan-Do; Sense-Analyze-Solve-Do Cybernetics Cycle

CTQI: Continuous-Total-Quality-Improvement

Evolution Life Cycle Adaptation: EDD Design-Reengineering-MRO-UTM-CRUD-ITD-OCA-OAU

Strategies: Agile, Lean, Spiral, Iterative

PROC: Operational Processes

SPC: Stored Program Control

(Ref: J. von Neumann)

Meta: metaSystem, Dual process, Cognitive Plane, Autonomics, Self-*, iLities Management, Refection *(Ref: D. Kahneman)*

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What Is A Robot?

(RADICALS) Digital Technology: Physical | Virtual | Augmentation

Cognitive, Smart, Intelligent: Bot, Agent, Server, Actor: Appliance, Device, Instrument, Tool, System, Infrastructure

RADICALS Systems:

Robots, Reactive +
Automata, Augmentation, Automated, Automation, Algorithms +
Drones, Digital, Distributed +
Intelligent +
Computer, Computational, Cybernetic +
Autonomic, Adaptive +
Learning
Self-*

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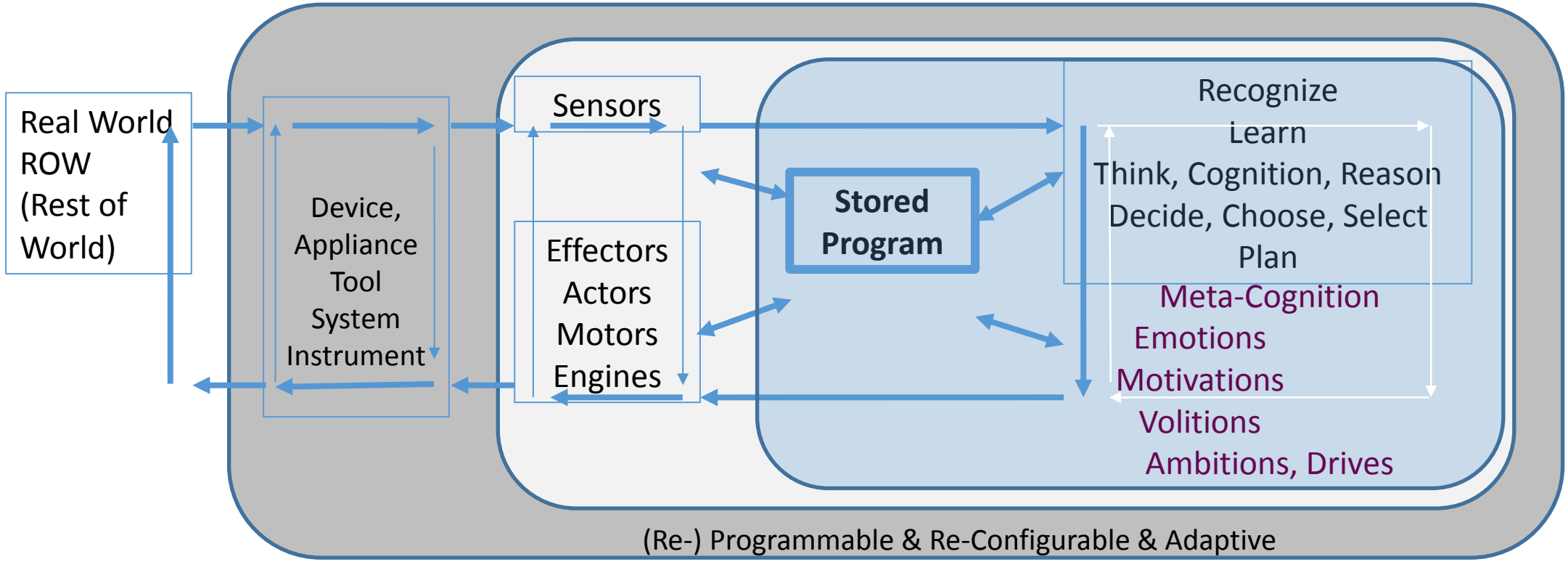

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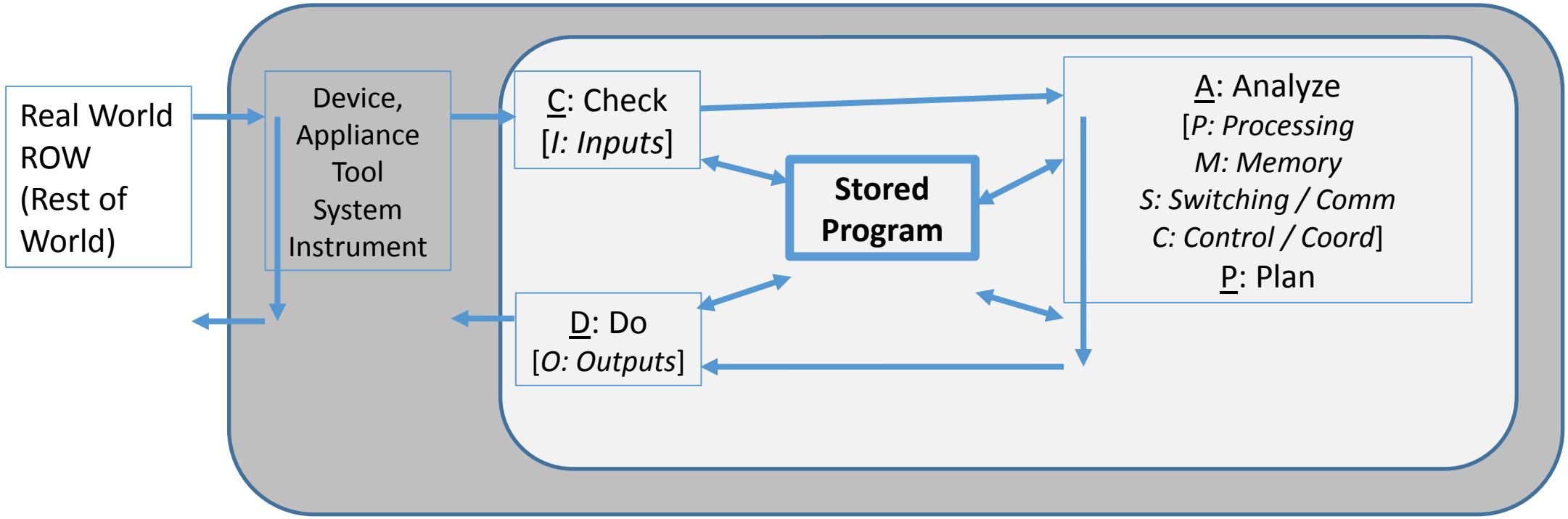
(RADICAL) Digital Technology: PDCA: PMSCIO



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Robot Programming:

Control Structures, Flow Control, Structured Programming:

Sequencing, serialization

Repetition, Looping, (recurrence, recursion)

Conditional Logic: switching, selection, branching, (TLC: Temporal Logic Controls)

Parallel, Concurrent, Distributed Programming:

Algorithmic Skeletons, Functional Combinators *(Ref: D. Cole, H. Curry, K. Iverson, J. Backus)*

Data Parallelism Schemas: SISD, SIMD, MIMD, MISD

MapReduce, Map, Fold, Zip

Process Models: Process Calculi, CSP, CPP, Sequence Charts *(Ref: UML)*

Multiple Representations of Code:

Pseudo-code Executable Code, Binary code, Digital code

Digital Circuits: ASICs, FPGA, PLA

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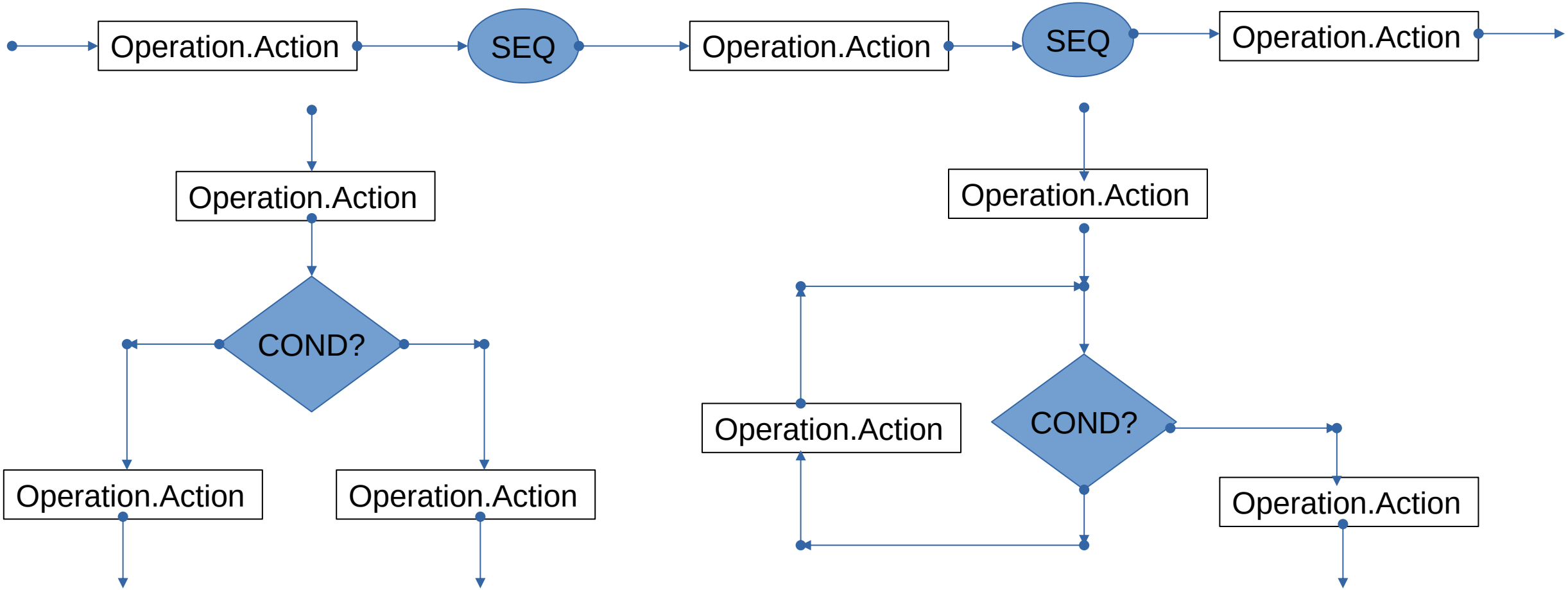
Robot Programming:Control Structures Viz



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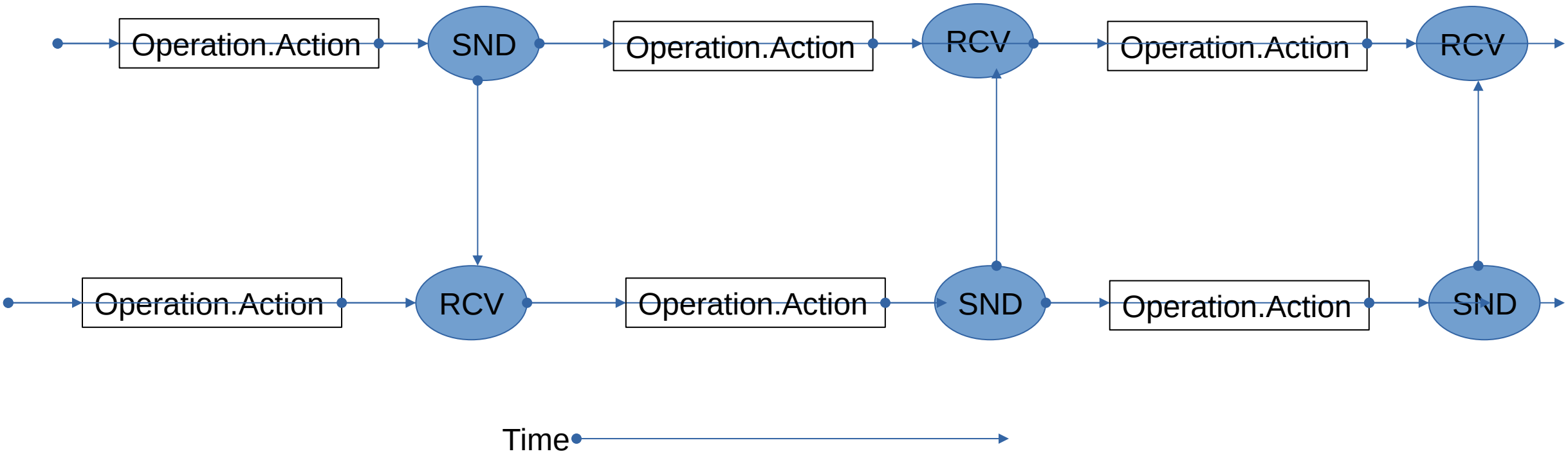
Robot Programming:Control Structures: Sequence Chart



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Robot Programming:

Want, Desire, Need, Wish, Requirement, Expectation, Anticipation
Expectation Violation, Problem, Challenge
(MAT) Motivation, Goal, Objective, Teleology || Ability || Trigger
Task, Agenda, Algorithm
(ORIC) Outcomes, Rewards, Investments, Continuations
App = Algorithm = Data + Manipulations
Data(Thematic Semantic Cases, ER:Relation.Entity.Attributes)
Data(ADT, OOP Class, Object)
Manipulations(P, M, S, C, IO)<CRUD|Data>, <Bra|Ket>
<Verb | Noun>; <Verb.Adverbs | Noun.Adjectives>
Control Structures: Sequence, Conditional Branching, Looping
Control Structures: Procedural, Parallel, Distributed, Networked,
Concurrent(Synchronized, Resource Sharing/Multi-Access Contention Coordination)
Actor, Agent, Bot, Agency, Ant, Sprite, Demon,
LEGO-like, Ikea-like, LittleBits, Educational Robots, STEM+A Robots
The 3Rs + 1: Reading, wRiting, aRithmetic + pRogramming

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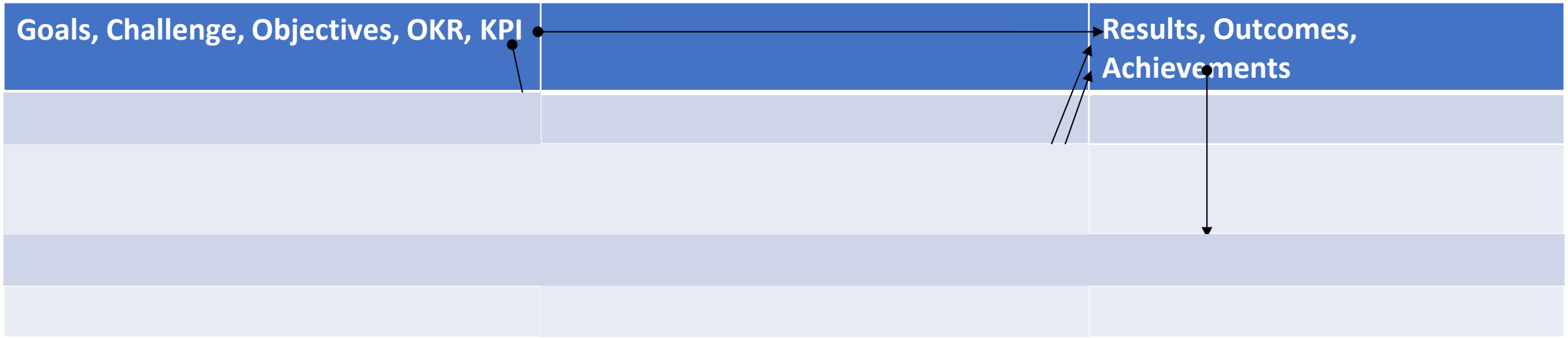
Project Canvas Method



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Problem-Solving Canvas Method (DESC Heuristics)

Problem, Challenge, Trouble, Trigger(1)		
	Understand, Decode (2)	Represent, Visualize, Encode (3)
	Solve: Try Options, Alternatives (4)	Solve: Select, Choose Solution (5)
Solution: Use, Utilize, Execute, Apply (8)	Solution: Implement, Embody (7)	Solve: Check, Validate Solution (6)

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Learning

Learn something: What? (Topics, Themes, Concepts) How? (Learning Styles)
Explore, Familiarize, Gain Experience, Mastery, Expertise, Deep Learning
Innovation, Creativity, Ingenuity, Problem-Solving, Disruptive, Active
When? Where? Continuous, Life-long Learning & Education.
Multi-paradigm Learning: Hands-on, Constructivist, Inquiry-based, Goal-driven

Game-Like: Easy Fun | Hard Fun | Social Fun | Epic, Serious Fun (N. Lazzaro)

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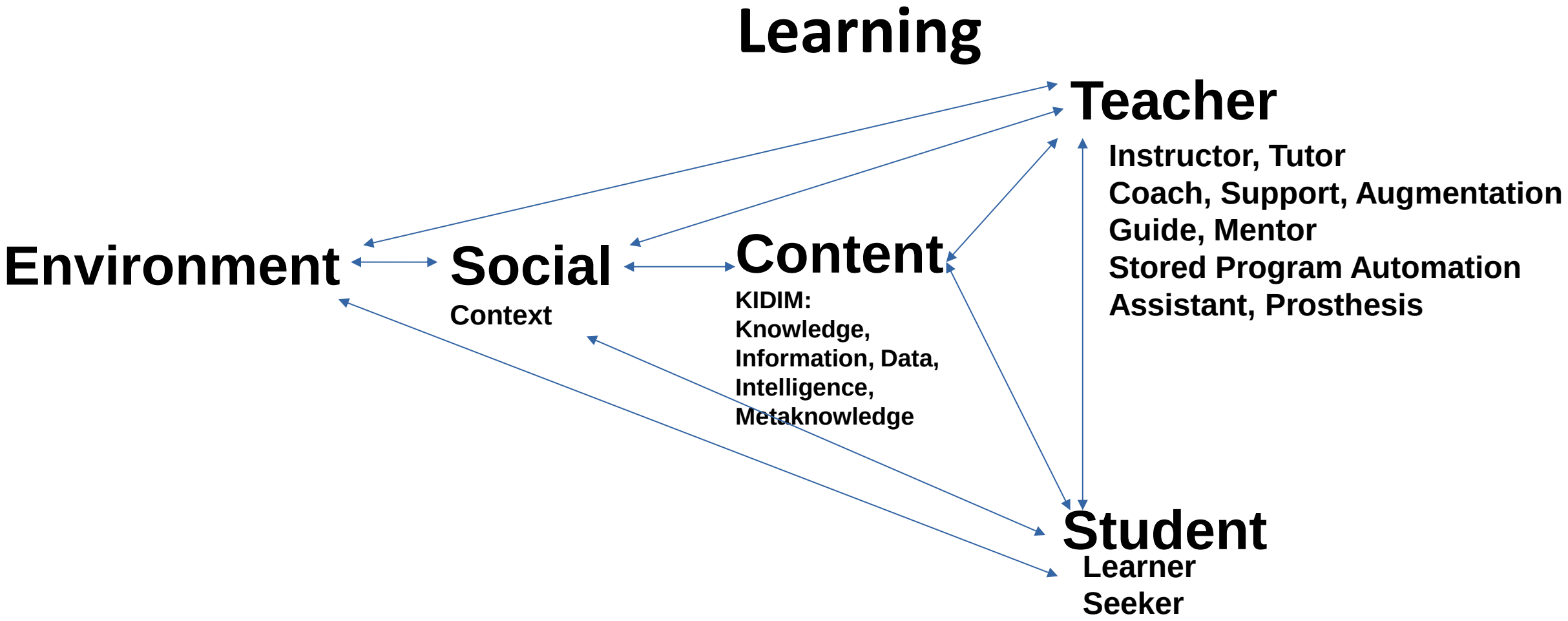

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(Gamification, Game-like) "Fun" Method

Game-Like: Easy Fun | Hard Fun | Social Fun | Epic, Serious Fun (N. Lazzaro)

Integrate SGM+PAV: Simulations + Games + Models + Play + Animations + Visualizations

Focus	"Fun" Learning, Problem-Solving (N. Lazzaro)
Build, Explore	Easy Fun + Hard Fun + Serious Fun + Social Fun
Program, Explore	Easy Fun + Hard Fun + Serious Fun + Social Fun
Use, Explore	Easy Fun + Hard Fun + Serious Fun + Social Fun
Apply	Easy Fun + Hard Fun + Serious Fun + Social Fun

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End-User Programming:

Programming as a Journey, Flow

Stored-Program Automata

(Ref: A. Turing, J. von Neumann)

Locus of Control

Algorithms: Control Structures

(Ref: Boehm-Jacopini)

Sequencing

Conditional Branching

Looping, Iteration, Repetition

Concurrent Shared-Resource Resource Sharing

Parallel Processing

Distributed Processing

Gecko Adhesion: Arrays, Bundles: Lamella-Setae-Spatulae

Insect Societies: Ants, Bees, Termites, Wasps,

Colony Organisms

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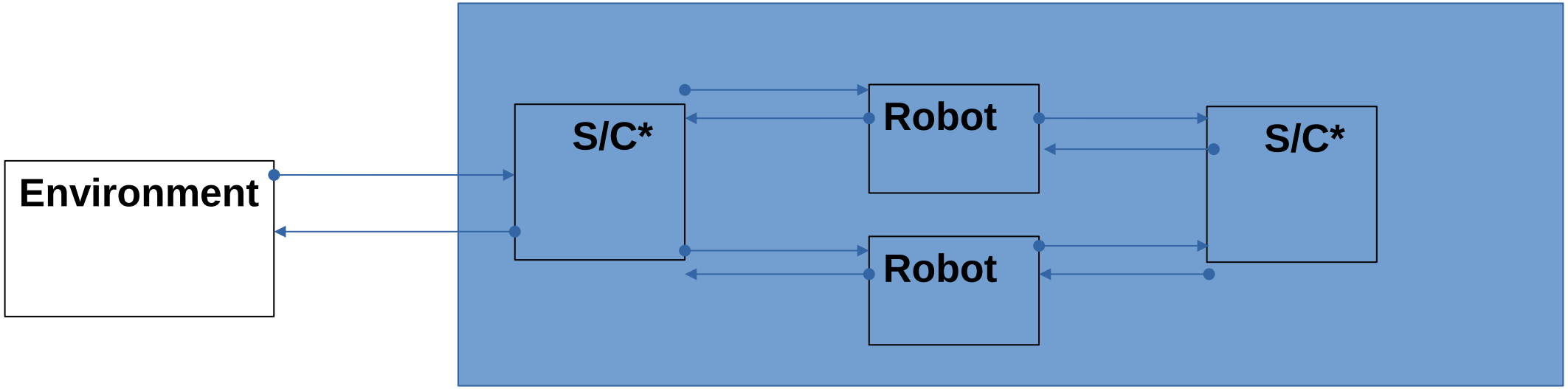
Robot-in-Context: Society of Robots



Society of Robots, Agents, Bots, Intelligent Assistants:

Swarm, Crowd, Pool, Complex, Ensemble, Organization, Organism, Colony Organism, Multi-archtiecture, Poly-architecture

Parallel, Distributed, Concurrent, Decentralized, Multi-Sided Platform (MSP, Uber-like), BlackBoard architecture

Interaction Models, Schemas, Patterns:

S/C*: Switching/Communications, Control, Cybernetics, Coordination, Choreography, Orchestration, Synchronization, Bulk Synchroization

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Robot Programming-in-Context:

SW: Applications, Services
SW: Middleware (MW)
SW: OS
SW: Firmware
HW

Web	Mobile	Internet	Server	Embedded
Desktop	Portable	Cloud	Grid	Implantable
Laptop	Smartphone	IOT	Supercomputer	Brain-Compter Intf
	Tablet	MSP: Multi-Sided Platform	Cloud	IOT
	Wearable			Wearable
	Hearable			Hearable

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Robot^iQK

Prototyping the Future
^Together for All Ages

Educational Robotics & Digital Technologies for Computational Thinking
for Resource-Limited Communities

Programming Paradigms & Styles

Multi-Paradigm
Procedural, Imperative
Object-Oriented
Functional, Function Style
Logic
Array
Parallel

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Programming with Scratch

Developed at MIT Media Labs

Assemble Computer Programs, Software

Use Lego-like Building Blocks Modules

Teach Anyone How to Program & Code

Including 4yr – 5yr olds & Above (All Ages)

ANYBODY Can Program!!!

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Projects

Projects: Mini-problems from the Real-World:
Fetch; Pick-&-Place; Sweep; Inspect;
Navigate, Traverse thru Barriers, Obstacles;
Recruit, Tandem Running; Follow
Me; Fly With Me;
Project Canvas Method

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Going Beyond Scratch

Scratch Scripting L. OOP L. Server L. Assembly

Professional Programming: High-Level Languages (HLL)
Formal Semantics: Translate, Compile Scratch into HLL; then HLL into ASIC or FPGA
Code Optimization: 50x Speed Up: Python C
Non-Professional Programming: Scripting Lang.
Novice Programmers, Expert Programmers

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Recap & Summary

Disruptive Innovations of Digital Technology, Automation, AI, Algorithms, Augmentation, Assistive, Cognitive Assistants, Future of Work, Human-Machine Collaboration

Global, Worldwide and National Movements to Inculcate Computational Thinking, Design Thinking, Computational STEM+A in K-12 Students: CS4ALL

Teach Anyone How to Program & Code. Including 4yr – 5yr olds & Above (All Ages). ANYBODY Can Program!!! Start with Lego-like Software Building Blocks & Modules that can be Assembled into Computational Structures

Encourage Citizens to Computationally Tackle Real World Problems and Grand Challenges

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Robot^iQK: Summer Robotics 2019

Thank You

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