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.

Contact: (718) 262-5358 Email: robotiq@york.cuny.edu

(2019)

YORK College CUNY

Educational Robotics & Digital Technologies for Computational Thinking

for Resource-Limited Communities

RobotiQK

Prototyping the Future ^Together for All Ages

Welcome

Dr. John-Thones Amenyo

Department of Mathematics & Computer Science

York College, CUNY

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Workshop Schedule

Day 1: Start

Day 2: Discovery

Day 3: Onboarding

Day 4: Scaffolding

Day 5: End-Game

(Ref: Y-K. Chou)

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Day 1 Schedule

RobotiqK: Summer Robotics Program:

Office of the Provost

Teach & Learn Computational Thinking:

Nationwide & Global Movement: CS4All: NSF, NY State, NYC

Prototype the Future Together at All Ages and Communities, to Understand the Coming World of

AI, Algorithms, Machine Learning, Big Data, Cloud Technology, Digital Automation

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Summer Robotics Program 2018

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 + 12)

What: Use Educational Robotics to Foster STEM+ Learning

How: Students Program Robots + Drones: Use Visual Programming

How: US Department of Education (DOE) Funded

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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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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 in Social Context

Future of Work, Jobs, Employment, Careers, Professions

Digital Technology

Automation

AI

Algorithms

Autonomics

Machine Learning

Computational Thinking

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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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Logistics:

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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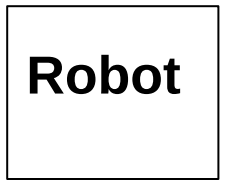
Robot



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,

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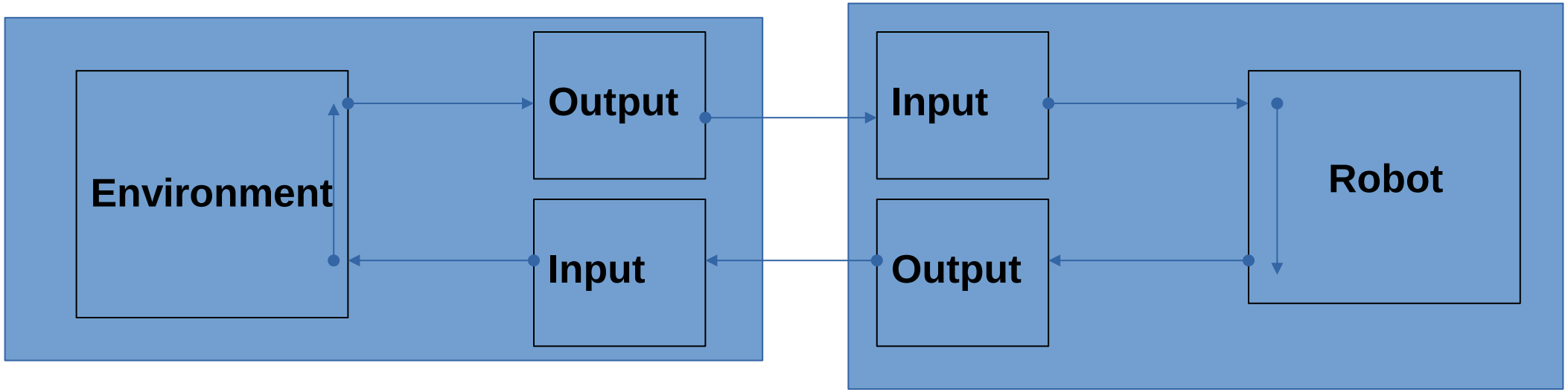
Robot-in-Context:



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

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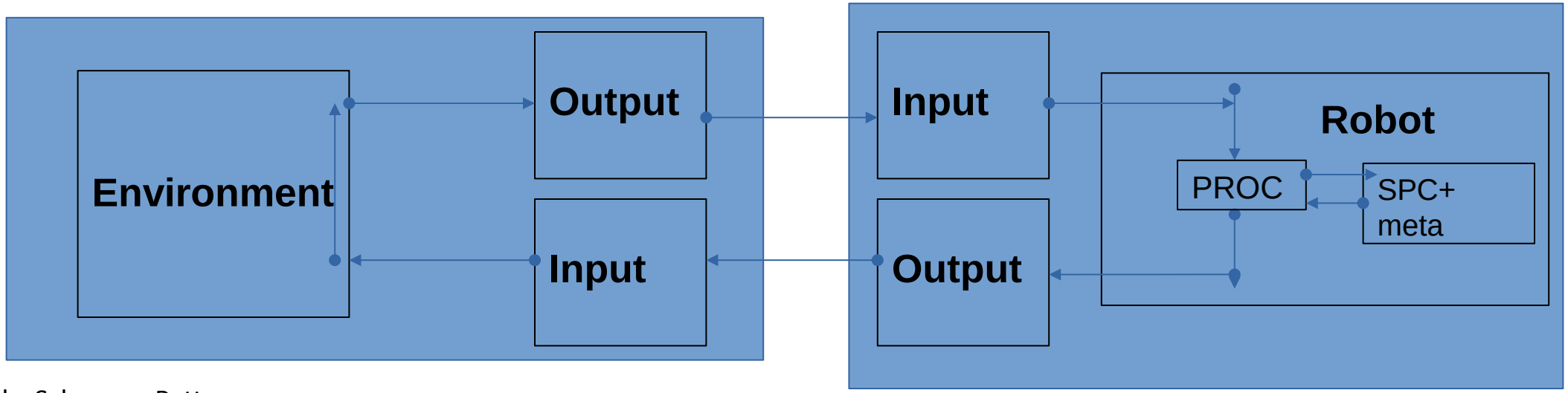

Interaction Models, Schemas, Patterns:

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

MVC: Model-View-Control

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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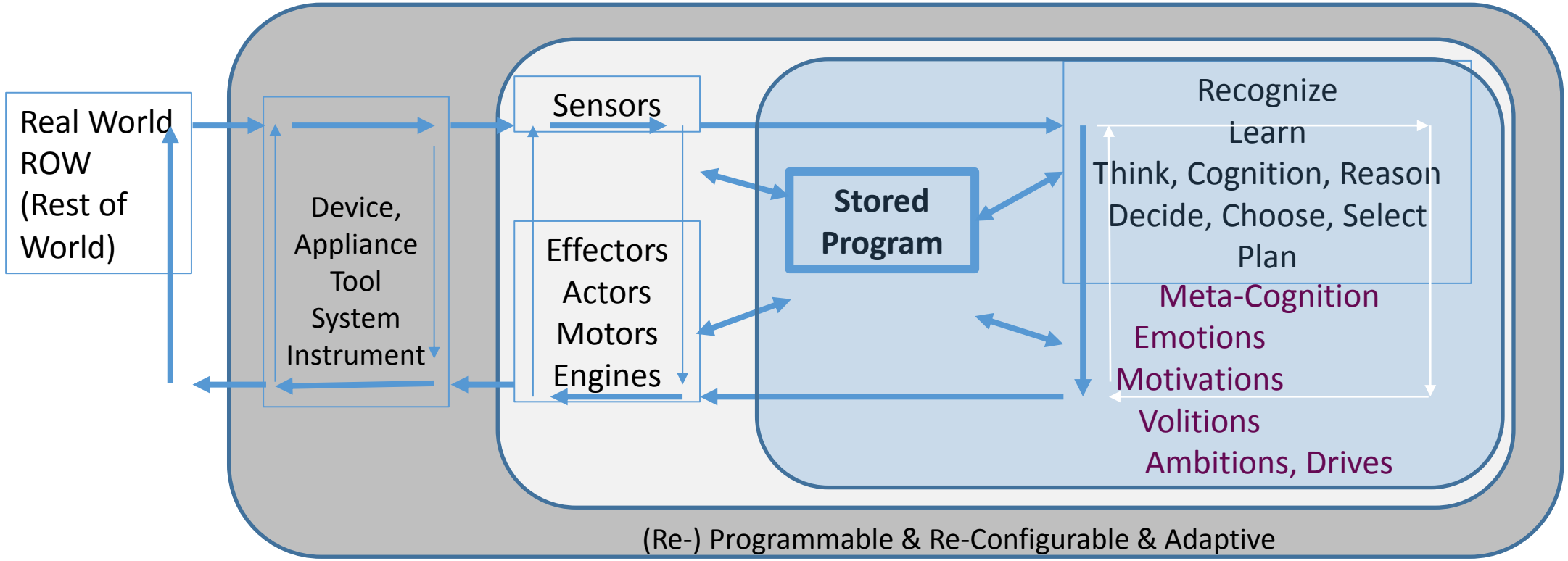
Reactive & Cybernetic & Intelligent Agent Model



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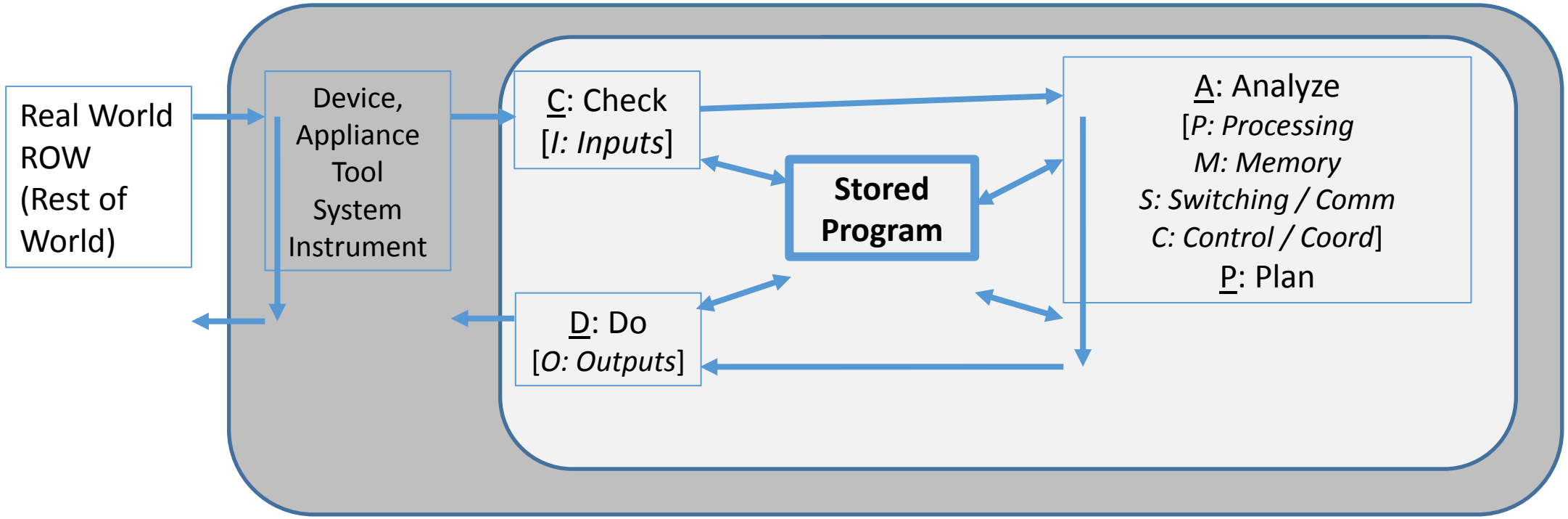
(RADICAL) Digital Technology: PDCA: PMSCIO



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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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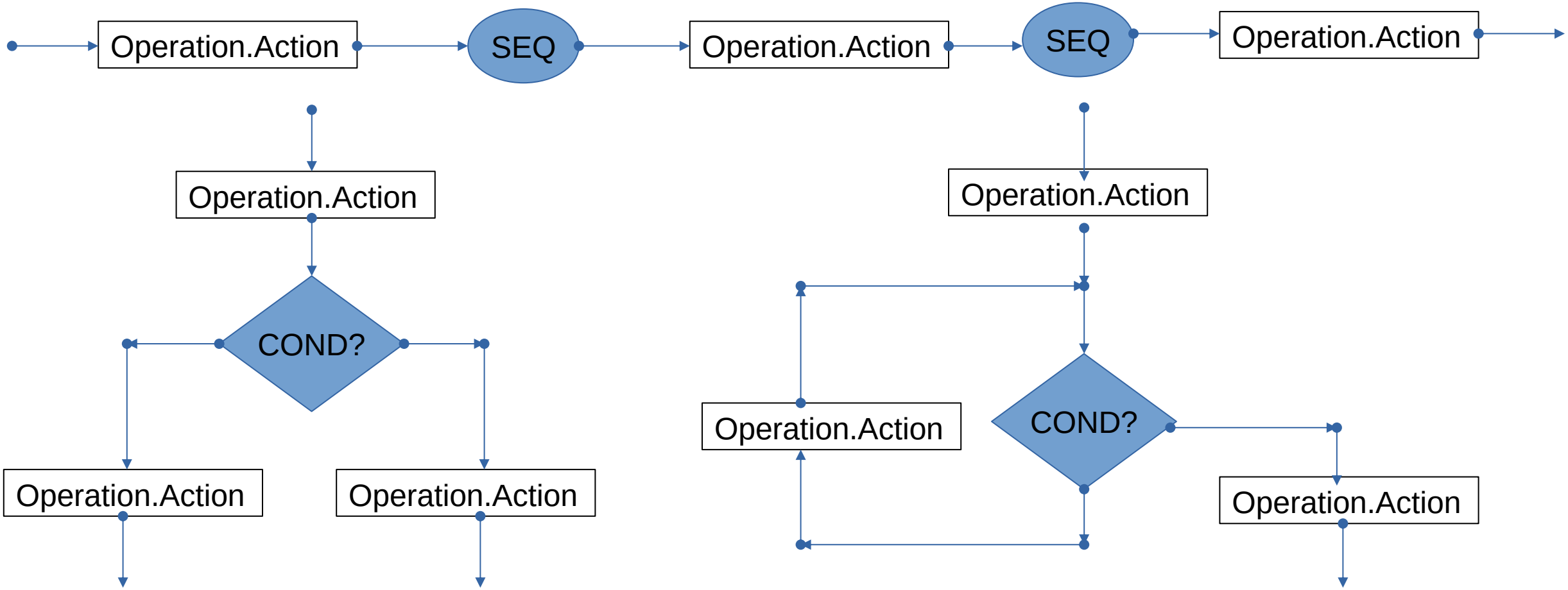
Robot Programming:Control Structures Viz



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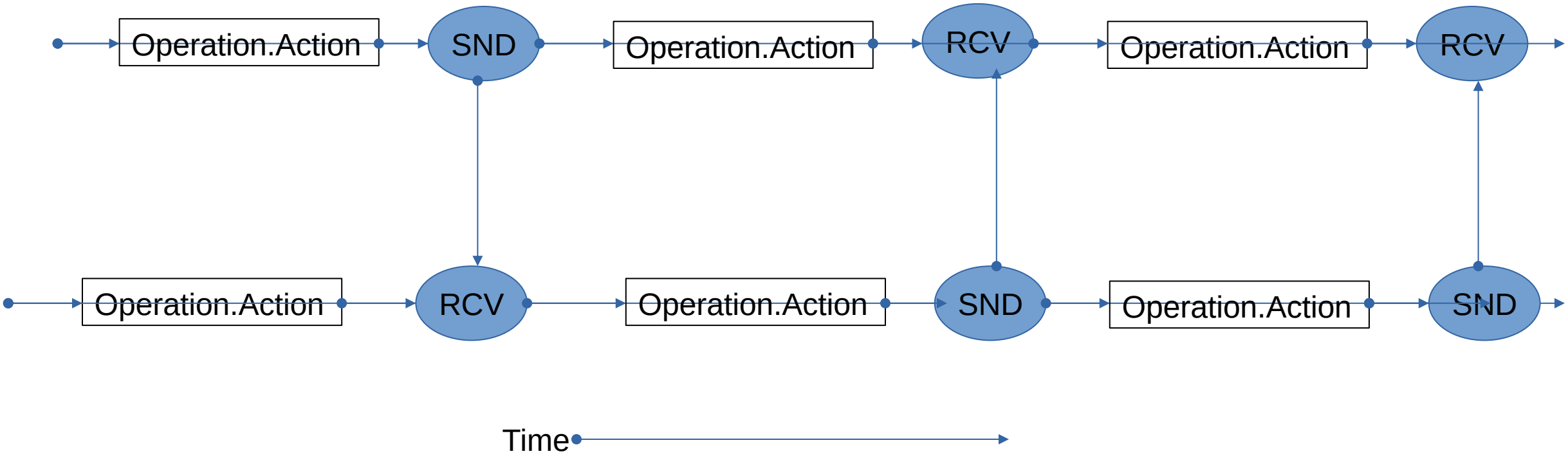
Robot Programming:Control Structures: Sequence Chart



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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

Goals, Challenge, Objectives, OKR, KPI		Results, Outcomes, Achievements
Motivations, Interests, Triggers		
Abilities, Skills, Experience, Knowledge	Resources, Technology, Capital, Support	
Pre-Investments, Data	**Behaviors, Activities, Performance**	Post-Investments: Time, Effort
	Results, Outcomes, Products, Data	

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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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(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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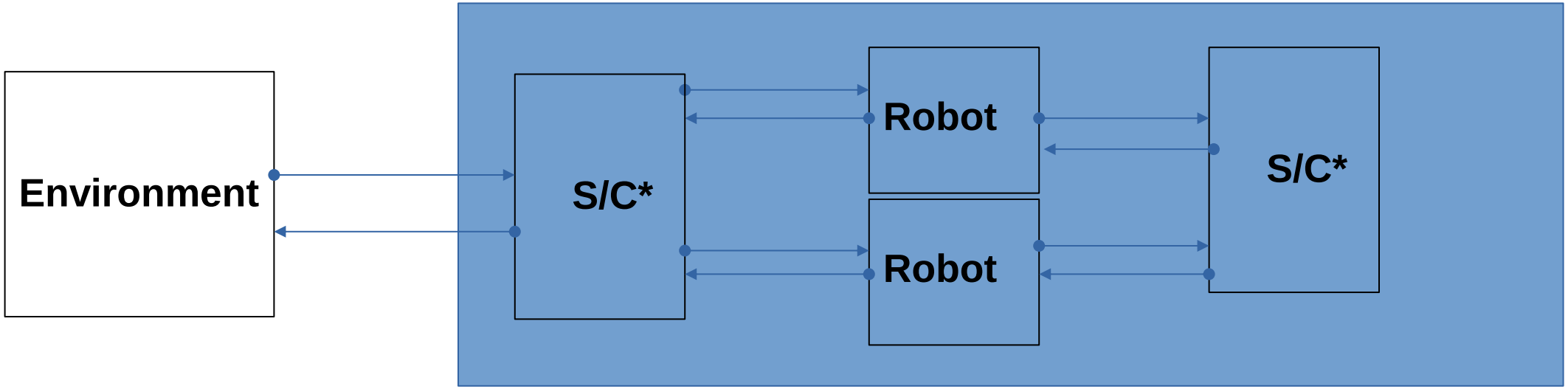
Robot-in-Context: Society of Robots



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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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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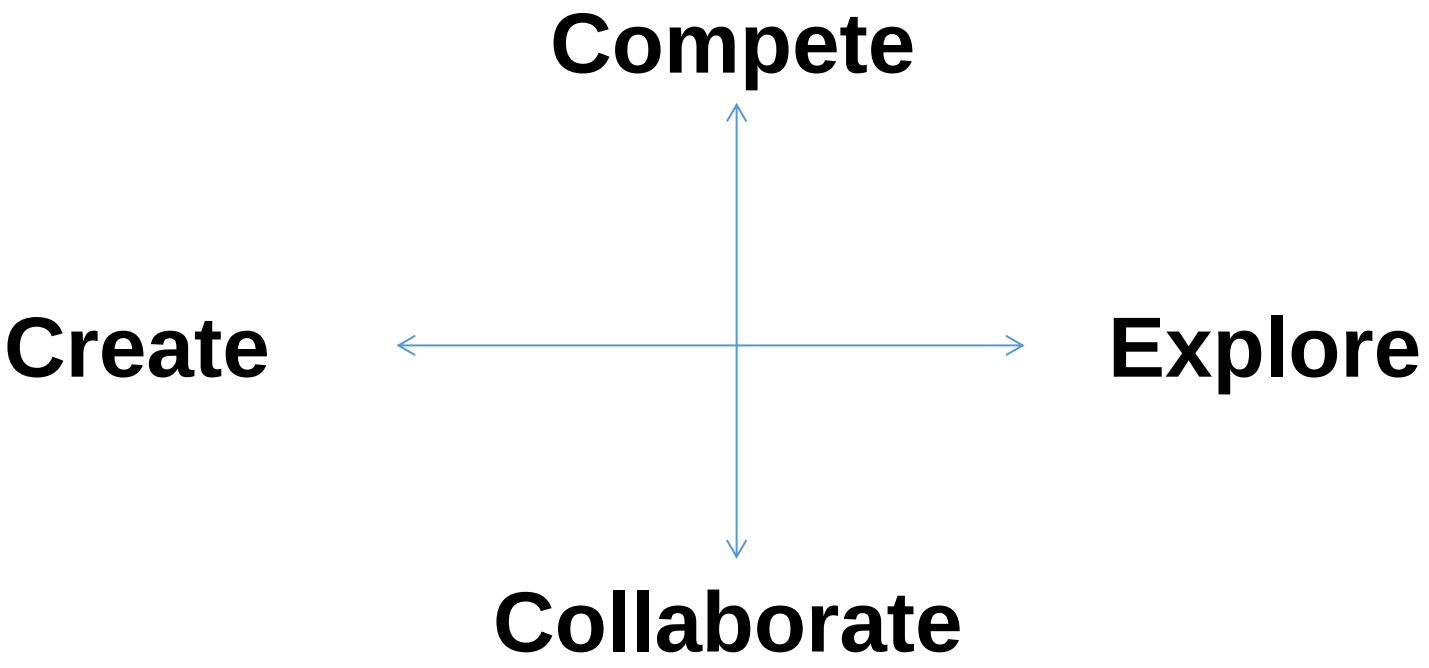
Goals, Drives, Tasks, Agendas



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Goals, Drives, Tasks, Agendas

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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