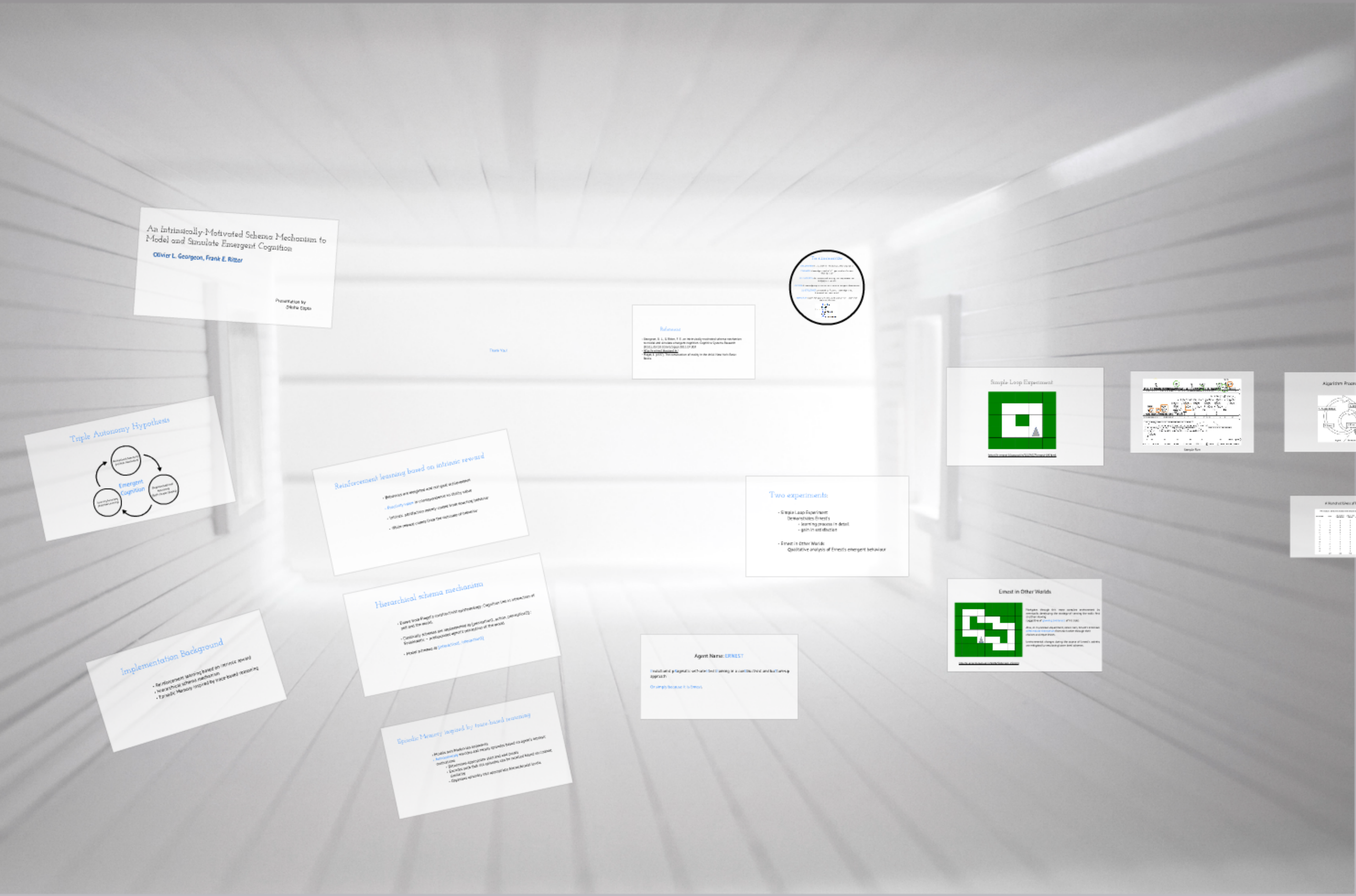
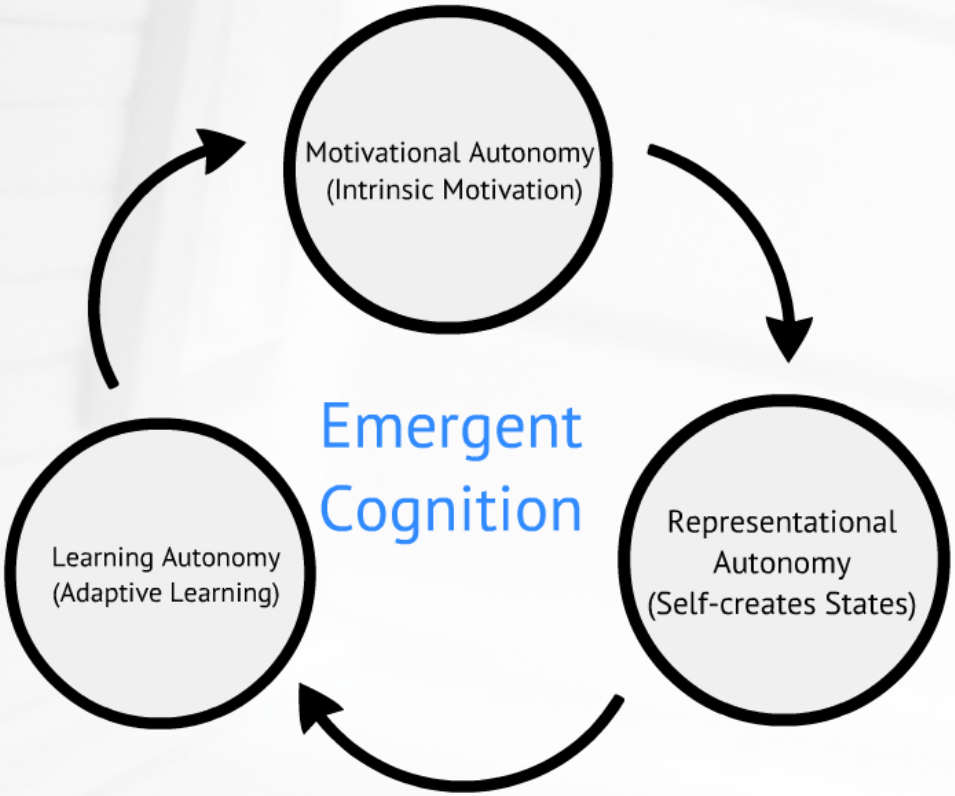

An Intrinsically-Motivated Schema Mechanism to Model and Simulate Emergent Cognition
Olivier L. Georgeon, Frank E. Ritter
Triple Autonomy Hypothesis
Emergent Cognition
Reinforcement learning based on intrinsic reward
Hierarchical schema mechanism
Implementation Background
Episodic Memory inspired by trace-based reasoning
Two experiments:
Simple Loop Experiment
Ernest in Other Worlds
Qualitative analysis of Ernest's emergent behaviour
Agent Name: ERNEST
Simple Loop Experiment
Ernest in Other Worlds

An Intrinsically-Motivated Schema Mechanism to Model and Simulate Emergent Cognition

Olivier L. Georgeon, Frank E. Ritter

Presentation by
Diksha Gupta

Triple Autonomy Hypothesis



Implementation Background

- Reinforcement learning based on intrinsic reward
- Hierarchical schema mechanism
- Episodic Memory inspired by trace-based reasoning

Reinforcement learning based on intrinsic reward

- Behaviors are weighted and not goal-achievement
- Proclivity value in correspondence to Utility value
- Intrinsic satisfaction merely comes from enacting behavior
- While reward comes from the outcome of behavior

Hierarchical schema mechanism

- Draws from Piaget's constructivist epistemology: Cognition lies in interaction of self and the world.
- Classically schemas are implemented as [perception1, action, perception2] : Problematic – presupposes agent's perception of the world
- Model schemas as [interaction1, interaction2]

Episodic Memory inspired by trace-based reasoning

- Models non-Markovian sequences
- Autonomously encodes and reuses episodes based on agent's intrinsic motivations
    - Determines appropriate start and end points
    - Encodes such that old episodes can be recalled based on context similarity
    - Organises episodes into appropriate hierarchicalal levels

Implementation Background

- Reinforcement learning based on intrinsic reward
- Hierarchical schema mechanism
- Episodic Memory inspired by trace-based reasoning

Agent Name: ERNEST

Evolutionist pRagmatic self-orieNted lEarning in a conStructivist and boTtom-up approach

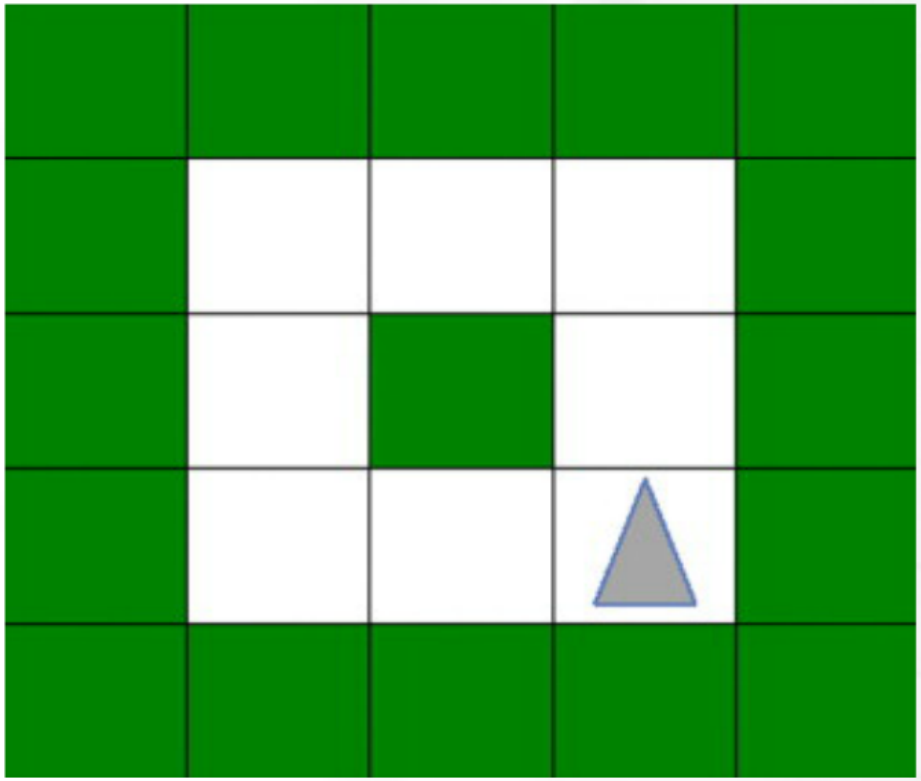
Or simply because it is Ernest.

Two experiments:

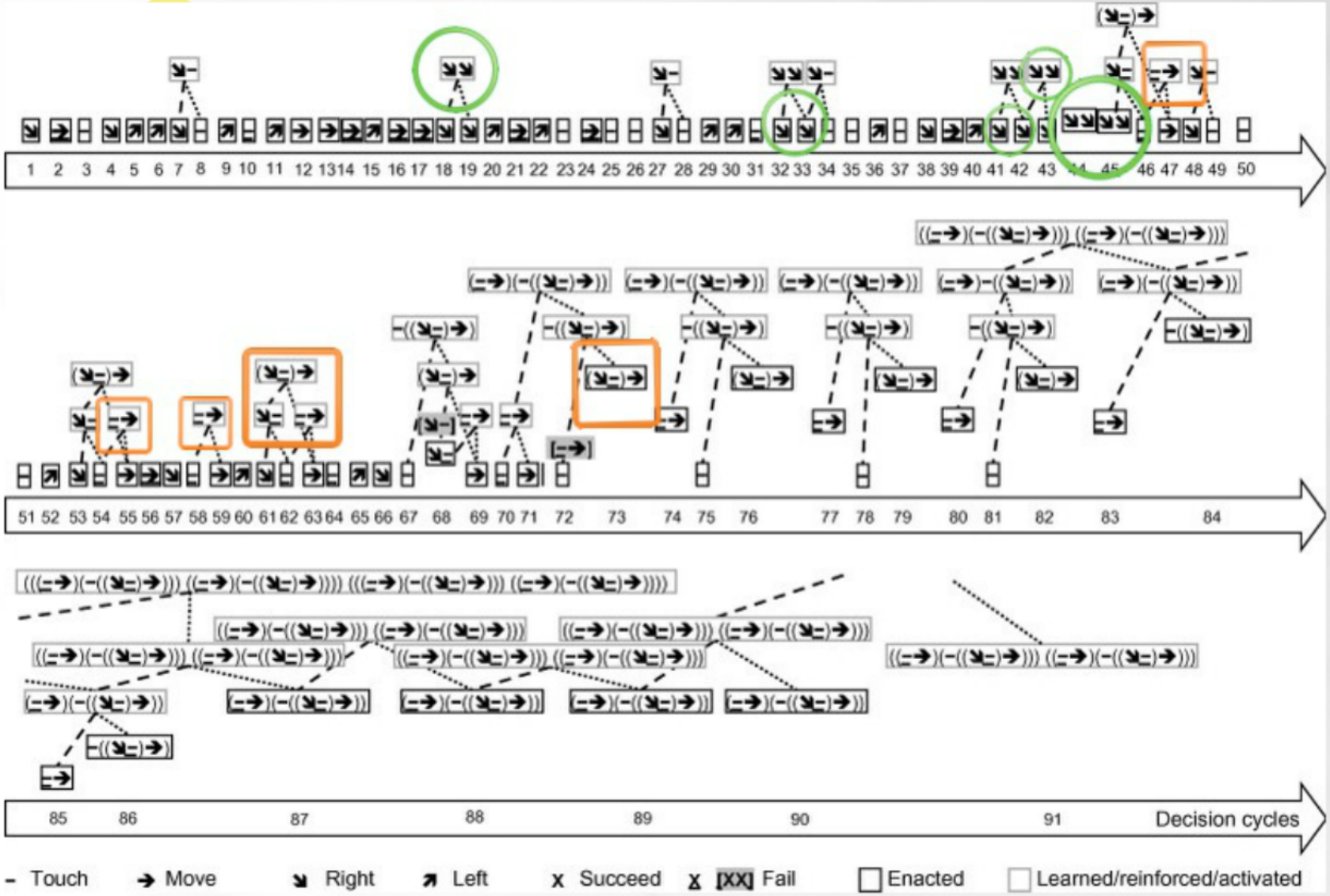
- Simple Loop Experiment
  Demonstrates Ernest's
  - learning process in detail
  - gain in satisfaction

- Ernest in Other Worlds
  Qualitative analysis of Ernest's emergent behaviour

Simple Loop Experiment

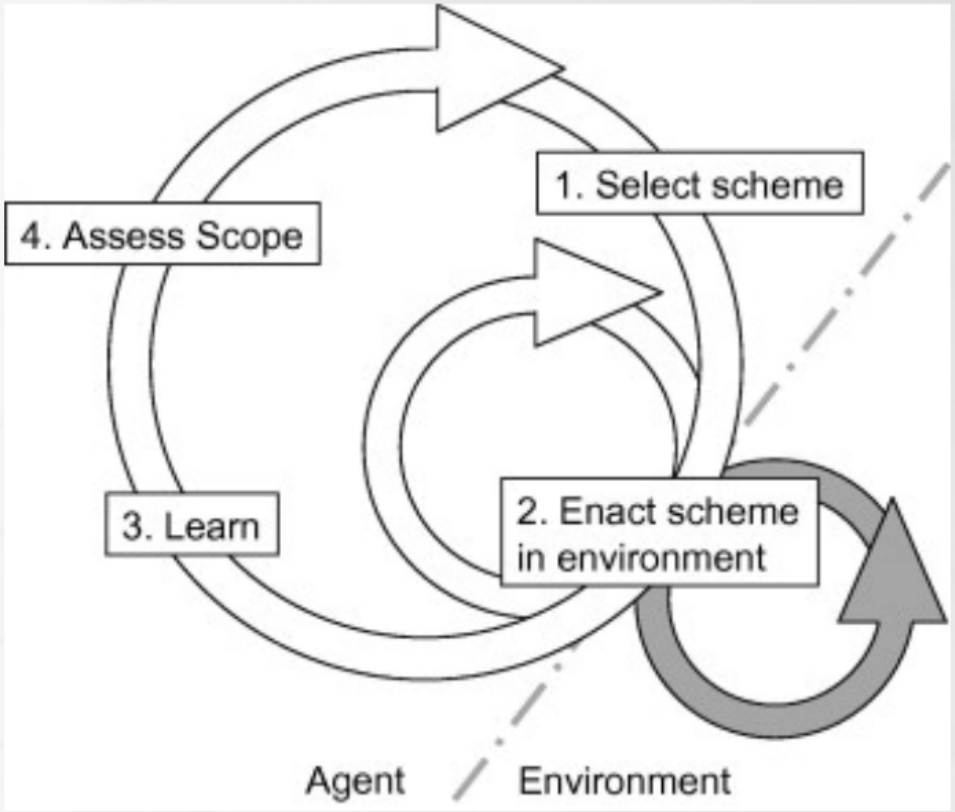


http://e-ernest.blogspot.in/2009/07/ernest-64.html


Decision cycles
Touch
Move
Right
Left
Succeed
Fail
Enacted
Learned/reinforced/activated

Sample Run

Algorithm Procedure



A Hundred Lives of Ernest

Performance of Ernest over a hundred runs sorted by satisfaction of final scheme.

Row number	Runs	Satisfaction of final scheme	Steps of final scheme	Average satisfaction/step	Decision Cycles to stability
1	22	9	3	3	50
2	22	9	4	2.25	79
3	4	9	5	1.8	75
4	4	8	4	2	69
5	16	8	5	1.6	62
6	18	8	6	1.33	84
7	1	7	5	1.4	76
8	1	7	6	1.17	109
9	1	7	7	1	108
10	2	6	8	0.75	116
11	3	4	4	1	61
12	1	4	5	0.8	95
13	3	3	3	1	71
14	2	2	5	0.4	96
	100	7.98	4.49	1.92	72

Two experiments:

- Simple Loop Experiment
  Demonstrates Ernest's
  - learning process in detail
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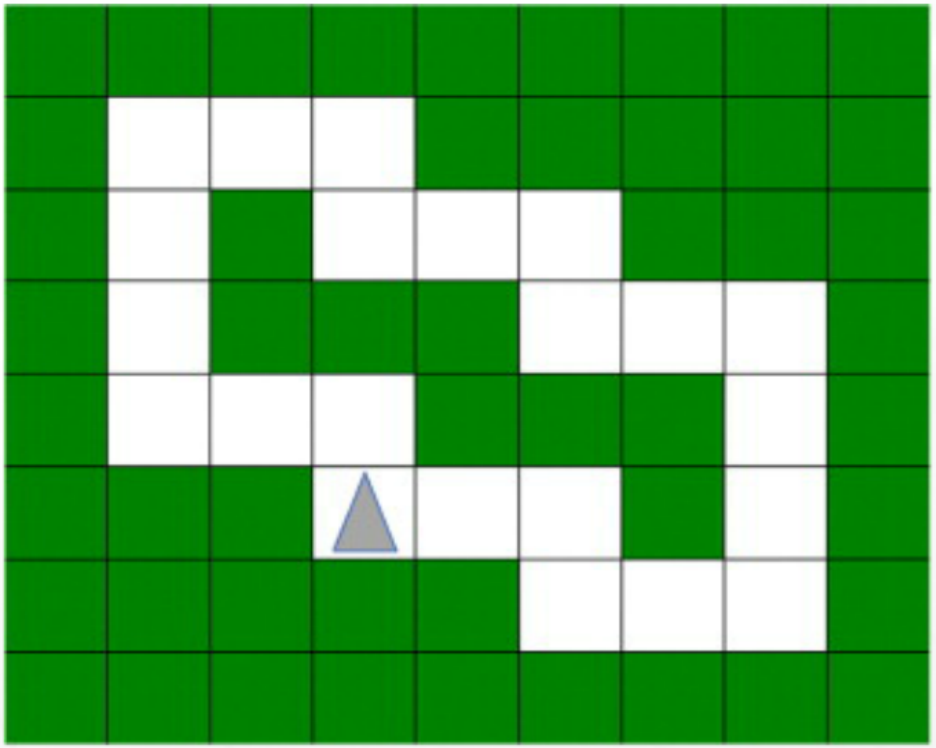
- Ernest in Other Worlds
  Qualitative analysis of Ernest's emergent behaviour

Ernest in Other Worlds



Navigates through this more complex environment by eventually developing the strategy of sensing the walls first and then moving:
suggestive of growing awareness of his sides.

Also, as in previous experiment, across runs, Ernest's instances differentiate themselves from each other through their choices and experiences.

Environmental changes during the course of Ernest's activity are mitigated by employing lower level schemes.

http://e-ernest.blogspot.in/2009/10/ernest-71.html

To summarize

EVOLUTIONIST: A "trial and error" method that keeps what works

PRAGMATIC: Knowledge is used to fulfill goals and satisfactions: "Meaning is use"

SELF-ORIENTED: An "unsupervised learning" that may however use pedagogical situations.

LEARNING: A knowledge acquisition that participates to the agent's development.

CONSTRUCTIVIST: as opposed to "Platonist", knowledge is not "discovered" but "constructed".

BOTTOM-UP: higher-level goals are constructed to better fulfill lower-level inborn satisfactions.

Evolutionist
p**R**agmatic
self-orie**N**ted
l**E**arning in a
con**S**tructivist and
bo**T**tom-up approach

References

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- http://e-ernest.blogspot.in/
- Piaget, J. (1937). The construction of reality in the child. New York: Basic Books.

Thank You!