# Scalable Agent Platforms with friendly interaction for modeling practical problems

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Scope

- Introduction: Agents based models
- The "Machanguitos" platform
- Addressing a practical problem
- Ongoing work
- Interest of ABM for Federated Clouds

## Introduction

- Elements of Computational Models for Concurrent Computing:
  - Agents
  - Actors
  - Entities\*
- Agent based computing: systems are composed of multiple structures (agents) interacting over an environment. Components:
  - Agents
    - Internal State
    - Update Function
  - Environment
- Actor model: the system is composed of a single structure: the Actor. An Actor can:
  - Send/Receive messages
  - Have a Internal State/Logic
  - Spawn other Actors

#### ABM vs MAS

- ABM = Agents-Based Models
- MAS = Multi-Agent Systems
- They have different goals:
  - ABM: search for explanatory insight into the collective behavior of agents obeying simple rules
  - MAS: computerized system composed of multiple interacting intelligent agents within an environment.
  - Multi-agent systems can be used to solve problems that are difficult or impossible for an individual agent or a monolithic system to solve
- There is a considerable overlap: as we will see, the proposed platform, Machanguitos, can be seen as

The Easiest Simplest Multi-Agent System

#### Introducing Machanguitos : Features

- Agent-Granularity: agents at various scale
   Only 1 scale
- Decision-making heuristics
  - Scripting Language for definition of Agent behavior
- Learning rules or adaptive processes
  - Agents with internal state
- An interaction topology
  - Stand-alone Agents
- An (non-agent) environment
  - Raster 2D

#### Introducing Machanguitos : scripting

```
function Agent:checkHill(delta)
  self.dx = ((-20 + math.random(40)) / 100.0)*delta);
  self.dy = ((-20 + math.random(40)) / 100.0)*delta);
  tempX = self.x + self.dx;
  tempY = self.y + self.dy;
  local area = raster.area:get( 0, tempX, tempY);
  if area > 0 then
    self.x = tempX;
    self.y = tempY;
    raster.position:increment(0, self.x, self.y, 200);
  end
end
function Agent:eatAndPoop(delta)
  local grass = raster.grass:get( 0, self.x, self.y);
  if (grass > 0) then
    raster.grass:increment(0, self.x, self.y, self.grassEated*delta);
  end
  local inc = self.grassToManure * delta;
  raster.manure:increment( 0, self.x, self.y, inc );
end
```

#### Machanguitos Run Model



#### Machanguitos Run States



#### Addressing a practical problem



# How to "assign" uncertainties to key but complex processes?

#### Practical Problem: impact of cattle management

- Extensive or semi-intensive
- >6000 cows
- >10000 sheeps
- Parameterization applied based on:
  - P and N deposits/animal
  - Run-off (7% if 30mm rain...)
- But real life is much more complex





### ABM simulation of cows impact

- 1200 iterations
- 10K 1M cows
- 5K 500K sheeps

	15K agents	150K agents	1.5M agents
Cores	seconds	seconds	seconds
4	179	1086	8787
8	142	651	5645
<del>16</del>	141	<del>722</del>	<del>6597</del>
<del>32</del>	<del>142</del>	<del>799</del>	<del>8149</del>
<del>6</del> 4	<del>167</del>	<del>1072</del>	<del>8289</del>
<del>128</del>	<del>206</del>	<del>1196</del>	<del>10759</del>



# On going work

Evolution of the Platform

- Better concurrent access to the data
- Add Actors properties
- Better definition of environment
- Other environments (Dynamic GIS)

Future of the Model

- Realistic scripts for cows and ships
- Realistic mineralization processes?
- Validation

#### Interest of ABM for Federated Clouds

Implementation as SaaS?

- Service orientation
- Collect scenarios, scripts
- Well suited to distributed execution
- Multilayer approach

Many areas of application

- Socio-economic systems
- Smart cities

#### Questions?

