

CSE 475 Creatures Project

Preliminary design outline

- Goals for the **Creatures** :
 - Do the same behavior for a little while
 - Behaviors start, then spread, then die out
- What is a Behavior?
 - Sound Gesture
 - Light Gesture
 - Linked Sound and Light Gestures

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Creatures Process Flow:

- a. Initialize stuff; select $x = \text{random}(0-15)$
- b. Radio off; Do Behavior[x]; Radio on
- c. Listen for Random(min1--max1) sec.
- d. SendMessage "I did Behavior x"
- e. Listen for Random(min2--max2) sec.
- f. Decide which behavior to do next
- g. go to b.

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Creatures Details: Listen

- Arriving packets need to be time-stamped
- Packets from Node 0 must be specially treated– they may contain global parameters
- Arriving packets must be strength-stamped for RSSI value– special radio stack required

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Creatures Details: Decide

- Need algorithm for what behavior to do next
- Similar to Cellular Automata, like Conway's Game of Life
- Goals:
 - do the same behavior for a little while
 - behaviors start, then spread, then die out

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What are Cellular Automata?

- Computer simulations which emulate the laws of nature
- Discrete time/space logical universes
- Complexity from simple rule set: reductionist approach
- Deterministic local physical model
- Rough estimation of nature: no precision
- Does not reflect 'closed sphere' life: can achieve same end results given rules and initial conditions

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History

- Original experiment created to see if simple rule system could create "universal computer"
- Universal Computer (Turing): a machine capable of emulating any kind of information process through simple rule system
- late 1960s: John Conway invents "Game of Life"

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Game of Life

- Simplest possible universe capable of computation
- Basic design: rectangular grid of “living” (on) and “dead” (off) cells
- Complex patterns result from simple structures
- In each generation, cells are governed by three simple rules
- Which patterns lead to stability? To chaos?

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Simulation Goals

- Avoid extremes: patterns that grow too quickly (unlimited) or patterns that die quickly
- Desirable behavior:
 - No initial patterns where unlimited growth is obvious through simple proof
 - Should discover initial patterns for which this occurs
 - Simple initial patterns should grow and change before ending by:
 - fading away completely
 - stabilizing the configuration
 - oscillating between 2 or more stable configurations
 - Behavior of population should be relatively unpredictable

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Conway's Rules

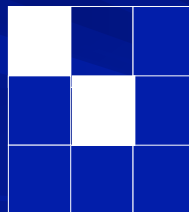
- **Death**: if the number of surrounding cells is less than 2 or greater than 3, the current cell dies
- **Survival**: if the number of living cells is exactly 2, or if the number of living cells is 3 (including the current cell), maintain status quo
- **Birth**: if the current cell is dead, but has three living cells surrounding it, it will come to life

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To work out the future color of any square...



We need to look at the eight squares around it...



To fully specify all possible combinations the rule would need to show 256 cases!

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The rules for “Life”

- If a square is black (“on”) then it will be **black** at the next step if **2 or 3** of its neighbouring squares are black
- A white (“off”) square will become **black** only if it has **exactly 3 black neighbouring squares**
- Otherwise a square will be white the next step (*overcrowded or lonely*)

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- So, we can have birth



- Or death...



- A nice implementation is at:

<http://www.math.com/students/wonders/life/life.html>

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Types of behaviour in the *Game of Life*...

1. **Still life objects** – unchanging (e.g. *four-block*)
2. Simple **repeating patterns** (oscillations)
3. Part of the system can leave the rest and travel (**movement** - *gliders*)
4. The system can **die out** completely
5. The system grows **randomly** before stabilising to predictable behaviour
6. The system grows forever (*quite rare and difficult to find*)

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Chaos...

- All behaviour in the Game of Life is **chaotic** – it depends extremely sensitively on the **starting state** and is completely altered if the system **changes** a little (e.g. *just like the weather*)

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Our Creatures



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Creatures Details: Decide

- Goals:
 - do the same behavior for a little while
 - behaviors start, then spread, then die out

- Algorithm?
 - Determine nearest behaviors
 - If our behavior = any of nearest n, then repeat behavior
 - If all same, switch to different behavior
 - If none same, switch to different behavior

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Creatures Details: Decide

■ Algorithm?

- Determine nearest behaviors
- If our behavior = any of nearest n, then
 - repeat behavior
- If all same, switch to different behavior
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■ How do we evaluate this?

■ How can we predict it's effectiveness?

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 - Decide which behavior to do next
 - go to b.
- How do we evaluate overall effectiveness?

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Homework Assignment:

- Invent a method of calculating whether 30 Creatures will ever do the same behavior at approximately the same time.
- Make three suggestions for improvement to any aspect of the flow or decision algorithm to improve chances of success
- Bring next Tuesday