

Swarm Programming

How to Program a MicroNet

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(Really) Brief History of Computer Science

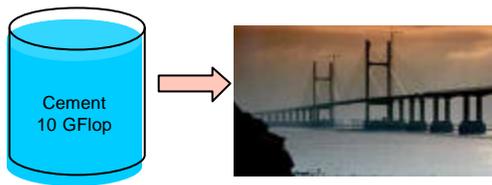
	1950	1960	1970	1980	1990	2001-
	"Programming in the Small"		"Programming in the Large"		"Programming the Swarm"	
Machines	Monolithic Computers	Fixed Networks of PCs	Billions of small, cheap unreliable devices in physical environments			
Programming Methods	First High-Level Languages	Modular Programming, Interfaces, Objects	Swarm Programming, Group Behaviors			
Reasoning Tools	Manual Proof of Properties of Trivial Programs	Tools for Reasoning about Distributed Programs	Tools for Reasoning about Groups in unpredictable environments			

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Programming the Swarm: Long-Range Goal



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Why this Might be Possible?

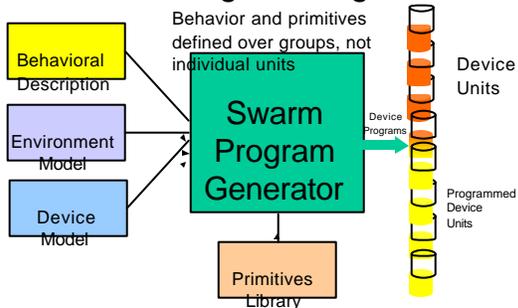
- Biology Does It
 - Ant routing
 - Find best route to food source using pheromone trails
 - Bee house-hunting
 - Reach consensus by dancing and split to new hive
 - Complex creatures self-organize from short DNA program and dumb chemicals
 - Genetic code for 2 humans differs in only 2M base pairs (.5 MB < 1% of Win2000)

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Swarm Programming Model



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Research Issues

- How can we describe the properties of swarm behaviors, devices and environments?
- What are the right primitives and combination mechanisms?
- How can we synthesize swarm programs with known functional and non-functional properties?
- Security
 - Can we use swarm programming to build systems that are resilient to classes of attack?
 - Can we produce swarm programs with known behavioral constraints?
 - Can we provide privacy on a MicroNet?

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