

## Decision Making

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## Decision Making

### What to do next?

- Strategic  (minutes+, symbolic)
- Tactical  (seconds, mixed)
- Reactive  (sub-second, continuous)

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## Factors in Decision Making

- What is involved?

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## Uncertainty in Decision Making

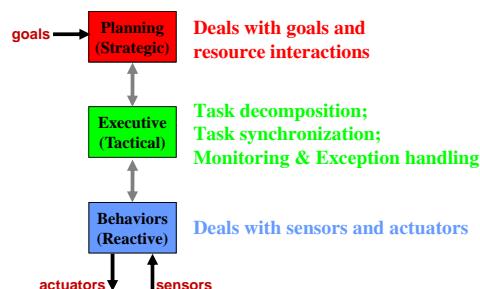
- Causes of Uncertainty
  - Perception
  - Actuation
  - Model of environment
- How to Handle Uncertainty
  - Strategic: Probabilistic reasoning
  - Tactical: Monitoring & replanning
  - Reactive: Feedback

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## An Agent Architecture



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## Decision Making in Playing Scrabble

- Strategic
- Tactical
- Reactive
- Cognitive
- Social
- Physical

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## Reactive Decision Making

- Goal achieving
- Largely stateless
- Robust
- *Typically, many concurrent behaviors with potentially conflicting objectives*

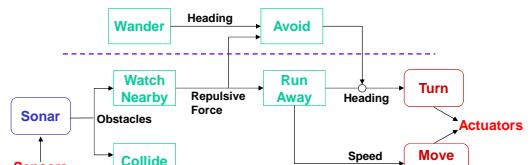
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## Subsumption Behaviors (Brooks)

- Hierarchical
- Behaviors may inhibit one another
- Behaviors may be arbitrated



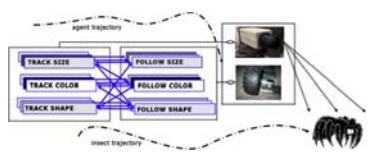
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## Spreading Activation

- Network of behaviors
- Excitation and Inhibition links
- Multiple influences may combine to “trigger”
- Over time, returns to homeostasis



Pezzulo

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## Strategic Decision Making

- Symbolic, look-ahead planning
  - Use of Heuristics (“rules of thumb”)
  - Abstract models
- Focus on cost/benefit
  - Maximize objective function (optimizing)
  - Bounded rationality (satisficing)

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## Generative Planning

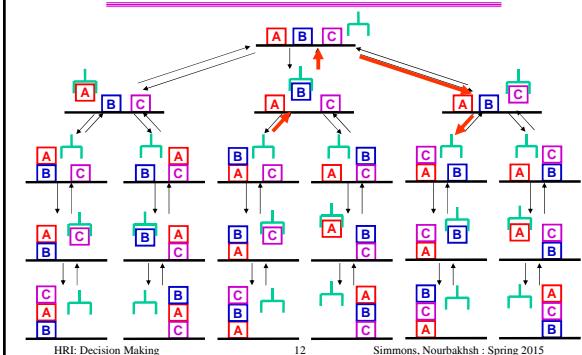
- Deterministic approaches
  - A\*
  - STRIPS
  - FF
- Probabilistic approaches
  - MDP
  - POMDP
  - Conditional random fields

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## STRIPS

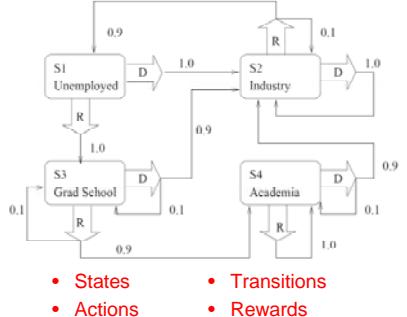


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### Markov Decision Process



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### Tactical Decision Making

- “Glue” that connects strategic and reactive levels
- Represent “how” rather than “what”
- Refine constraints from strategic level / Monitor activities of reactive level

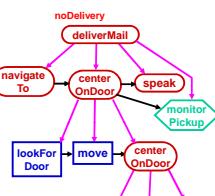
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### Hierarchical Task Decomposition

- Decompose tasks into sequences of sub-tasks
  - Temporal constraints
  - Resource constraints
- Add execution monitors and error handlers



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### Replanning/Determinization

- Assume world has no uncertainty
- Plan deterministically
- Execute, keeping track of uncertainty
- Replan if next action probably not appropriate
- **Issues?**

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