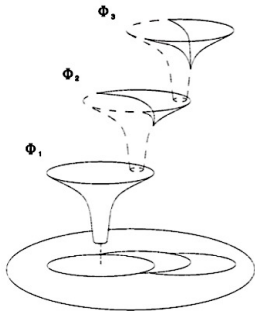
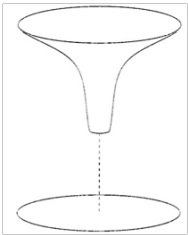


# Sequential Composition: Back-Chaining Basins



Burridge et.al. [1996]—Juggling obstacle avoidance



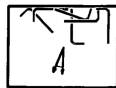
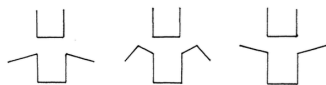
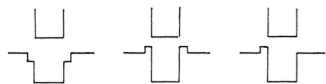
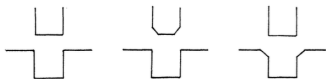
<https://www.youtube.com/watch?v=NfdG8ZZdtg>

# Sequential Composition: Examples from the Literature

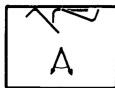
Lozano-Perez et. al. [1984]—peg in hole

Erdmann and Mason [1988]—sensorless tray tilting manipulation

Majumdar and Tedrake [2013]—Funnel libraries



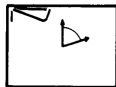
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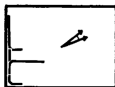
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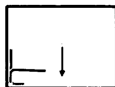
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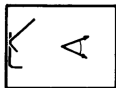
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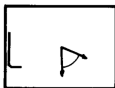
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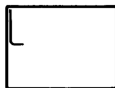
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7



8



9

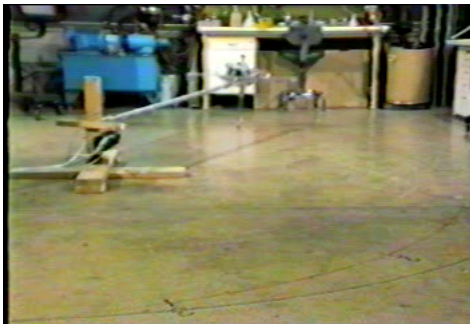


<https://www.youtube.com/watch?v=cESFpLg3b50>

# Parallel Composition: Idea and Examples

Two juggle—Rizzi and Koditschek  
[1994]

Raibert [1986]



<https://www.youtube.com/watch?v=u8I7EXXgTvk>

# Summary

- Robot control can be thought of as flowing “downhill” on artificial energy functions
- Sequential composition formalizes a sequence of tasks using back-chaining of basins
  - Sequencing coarse manipulation: juggling to palming
  - Assembly tasks
  - ...
- Parallel composition describes satisfying multiple objectives at once
  - Controlling multiple DoFs for hopping etc.
  - Juggling two balls
  - ... (more coming in 4.2)