



# TinySoar: Soar for Lego MindStorms

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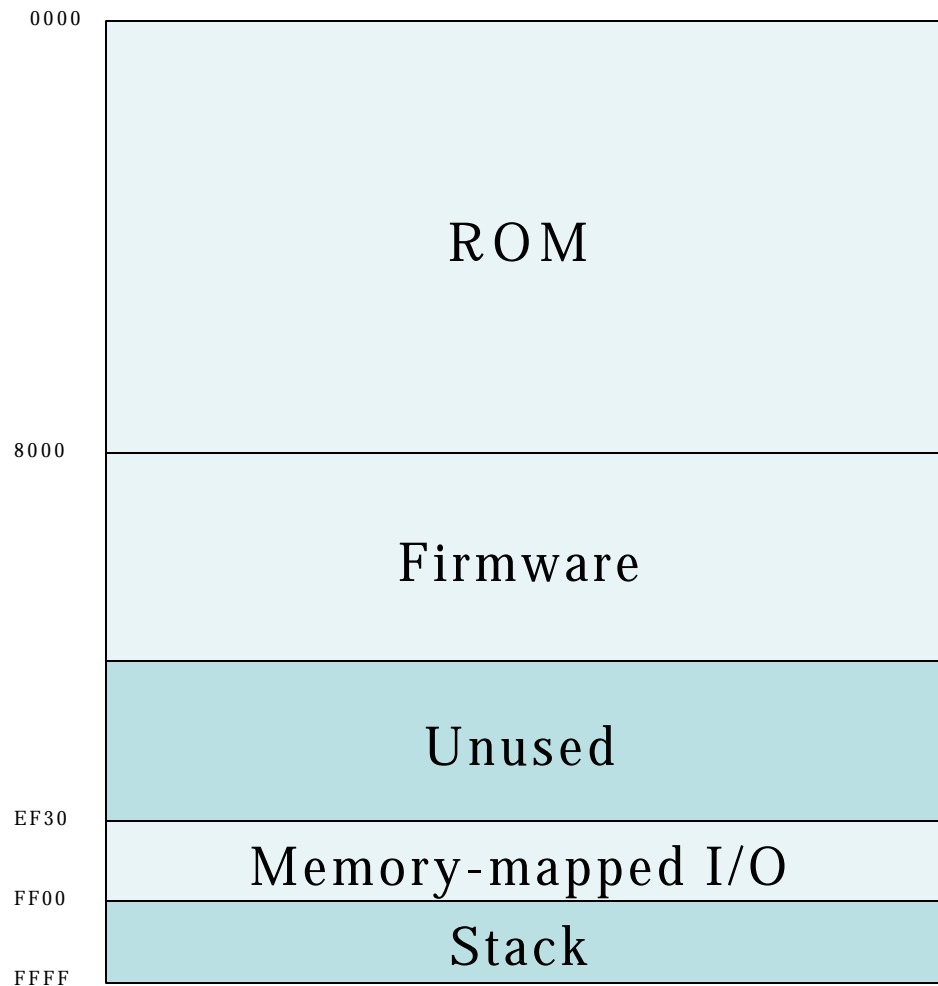
# Background

- Soar
  - Integrated architecture for planning, acting, learning
  - Wants to get out into the Real World!
  - 32-bit workstation codebase
- Lego MindStorms
  - Simple, cheap, popular robotics platform
  - Procedural programming
  - Extremely limited resources

**The Hack: Wedge Soar onto the Lego Mindstorms RCX.**

# Lego Mindstorms RCX

- 16 bit H8/300 CPU
- ~32K RAM
- 3 10-bit A/D inputs
- 3 output ports





# Making Soar Fit

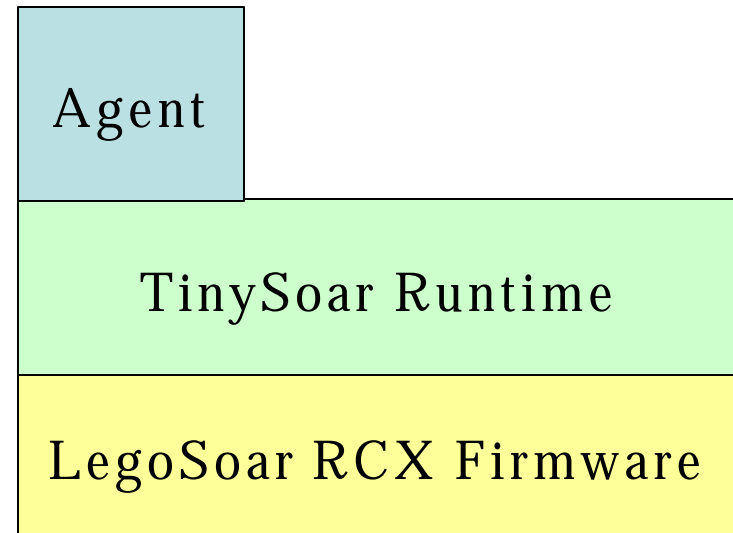
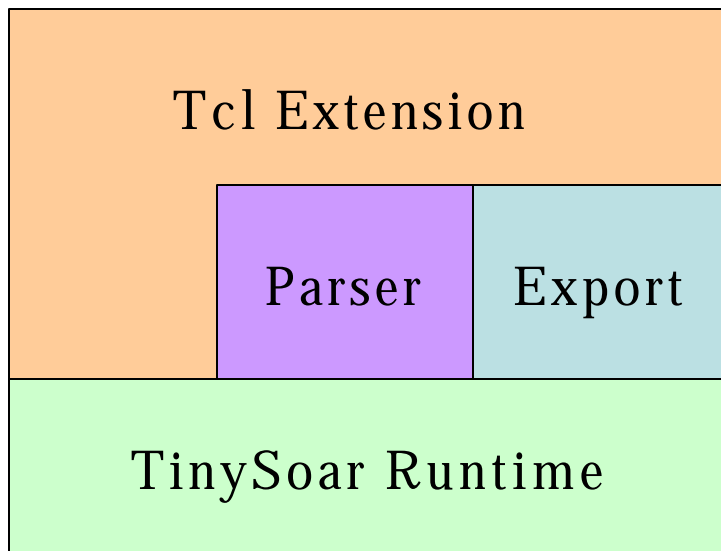
- Trade speed for space
  - No left-/right-unlinking
  - Design for small data structures
  - $O(n)$  instead of  $O(1)$
  - Bit-packing bonanza
- Simplify
  - No direct manipulation of WMEs
  - No conjunctive negative conditions
  - No interpreted RHS actions
  - De-generalize (e.g., `switch` instead of callbacks)
- Modularize



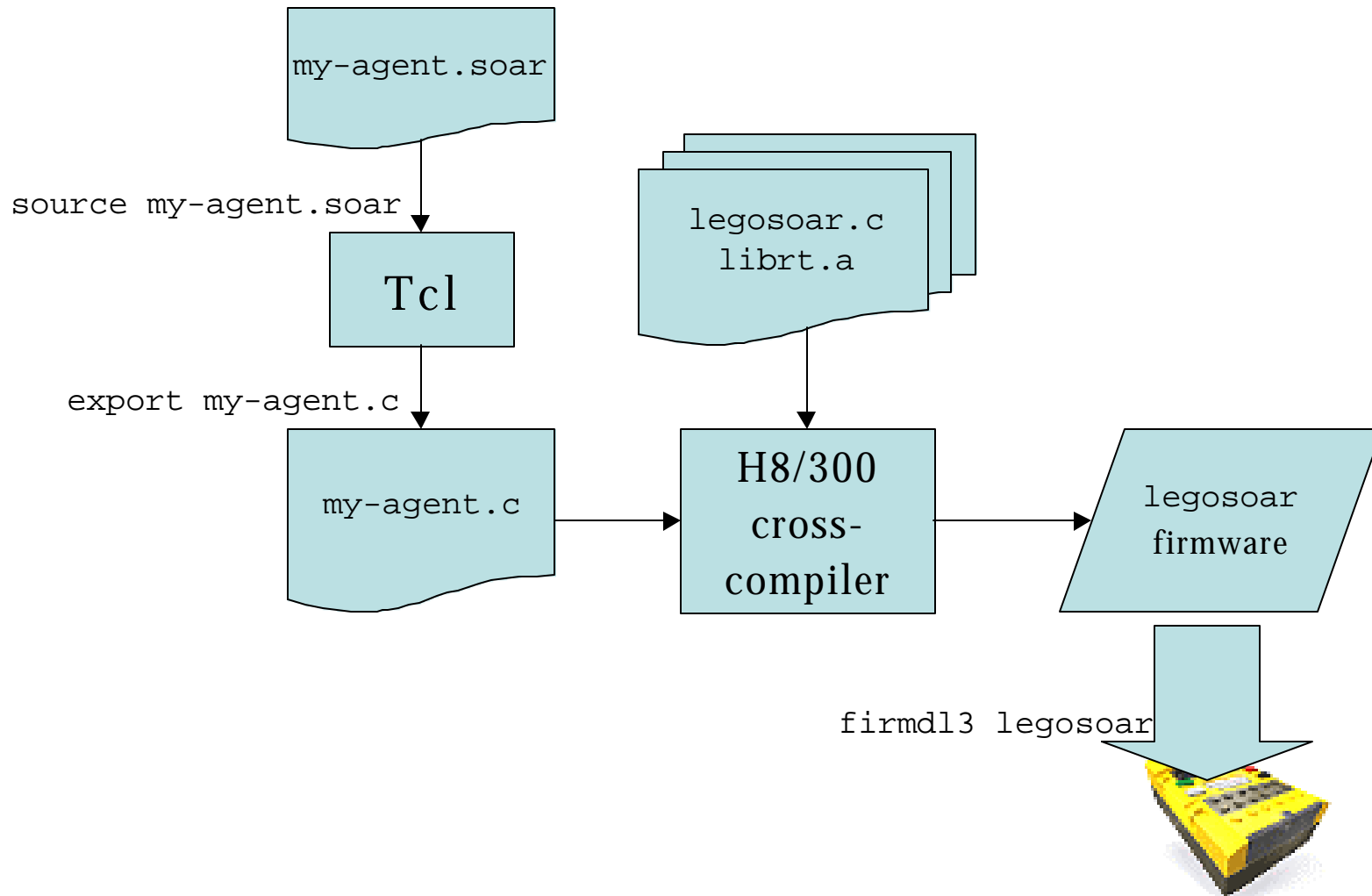
# TinySoar Architecture

Host

RCX



# Soup to Nuts





# Demo: line-tracker.soar

- Simple agent that will find and follow a dark line
- Operators: find-line, track-line, spin
- Typical input-encoding production

```
sp {elaborate*over-line
    (state <s> ^io.input-ink.sensor-1 >= +790)
-->
(<s> ^over-line t)}
```

- Typical output production

```
sp {find-line*implement*move-forward
    (state <s> ^operator.name find-line
        ^io.output-link <out>)
-->
(<out> ^motor-a forward ^motor-c forward)}
```



# Footprint

H8/300 Code	Static Data	Dynamic Data
11KB	~200B/production	~100B/instantiation, ~20B/preference, ~8B/WME

- 19KB RAM leaves room for about:
  - 40 productions
  - 70 instantiations
  - 150 prefs, 125 WMEs





# What Works, What Doesn't

## *Implemented*

- Preference semantics
- Operator selection
- Basic elaboration, decision cycle

## *To Do*

- + Chunking, justifications, impasses
- ? Conjunctive negative conditions
- ? RHS expressions



# Conclusion

- Future plans
  - Push harder on space optimization
  - Chunking, RCX simulator
  - Cool robots! (Any ideas?)
  - PalmOS?
- For source code, documentation, and more:  
<<http://tinysoar.sourceforge.net/>>