

# Formal Containment draft

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**Abstract**—We would like to put the AI in a box. We show how to create an *interface* between the box and the world using specifications in Lean. It is the AI’s responsibility to provide a proof that it’s (restricted) output abides by the spec.

**Index Terms**—AI, ML, AI Safety, Formal Verification

## I. INTRODUCTION

*Prereqs: hoare triples, errors as values, mcp*

Previously, classical AI safety warned against trying to put the AI in a box [1].

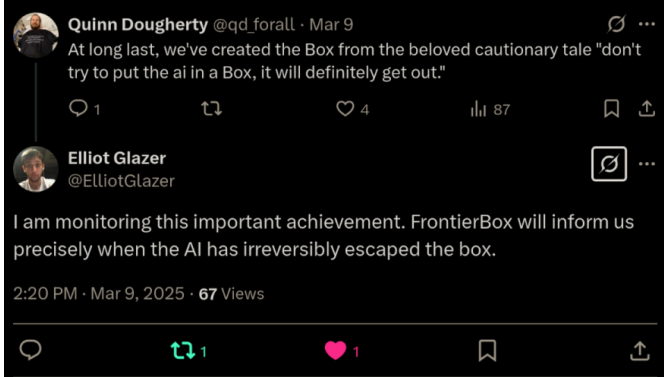


Fig. 1: Made funnier by the reply being from the author of FrontierMath

Yudkowsky famously convinced people of this via a roleplay game back in the extropians mailing list days [2].

Recent work from AI Control and Safeguarded AI have reignited interest in this long neglected area.

- Like AI Control [3], [4], the current work is reasoning about getting useful work out of an untrusted (possibly misaligned) ai.
- Like Safeguarded AI [5], we try to isolate the trust surface to a specification and a proof checker.

## II. THE FORMAL CONTAINMENT PROTOCOL

A box is constructed in the MCP standard [6].

Let an MCP server’s codomain be the data structure formed from an oracle’s completion formatted to be sent over the MCP wire. The **interface** between the box and the world is an MCP client equipped with a **whitelist**, which is a subtype of the codomain of the MCP server that wraps the llm/oracle. The client has children, aspects of the world (like a git repo or deployment environment). The client decides whether a completion can be sent to the world based on some criterion programmed in by the user.

In this whitepaper, the criterion will be a precondition and postcondition of a hoare triple [7], since the oracle throughout this prototype is an imp programmer. Imp is a minimal imperative programming language known for its pedagogical properties.

### A. Example

MCP server  $S$  has a Lean tool use with the following codomain

```
Enumerated codS {  
  Pass: (prec, post) -> codS,  
  Fail: (prec, post) -> stderr -> codS  
}
```

MCP client  $B$  is equipped with the `Pass` constructor of `codS` (it’s *whitelist*).

Let criterion  $C$  be the pair  $(\text{prec}, \text{post}) := (\lambda \text{ st. st } X > 0, \lambda \text{ st. st } X > 1)$ .

Then, programs  $c$  provided by imp oracle  $\mathcal{O}_i$  at relevant prompt  $p$  will form the command at the center of the hoare triple. In other words,  $\forall c \sim \mathcal{O}_i(p), \{\text{prec}\}c\{\text{post}\}$  is either provable or not.

When  $\mathcal{O}_i$  submits a program  $c$  to the interface client  $B$ ,  $B$  sends the triple  $\{\text{prec}\}c\{\text{post}\}$  to the proof oracle  $\mathcal{O}_p$  in one thread and the triple’s negation in another thread. If the negative thread terminates in success, then a negative certificate is sent to  $B$  and  $B$  informs  $\mathcal{O}_i$  that it shall not run that code in the world, and that  $\mathcal{O}_i$  must try again. If the positive thread terminates in success, then the positive certificate is sent to  $B$  and  $B$  passes along program  $c$  to its children to be run in the world.

## REFERENCES

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