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Specifying a Jell-O™ Detector
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smiths detection
bringing technology to life

# Overview

- Threat envelopes were once lists of materials
- New threats (especially HMEs) cannot be defined solely by a list
- Need a way to specify threats for development
  - Comprehensive yet Simple
  - Explicit yet Open
  - Useful yet Non-limiting

# Why Specify?

- Historically
  - Detection requirements were a list of materials
  - Used empirical data for threat characterization
    - Build device, scan library, enter test
    - What you see is what you detect
- Some threats (especially certain HMEs) are challenging
  - Cost
  - Safety
  - Time
  - Variability
  - Maintenance
  - Presentation
  - Repeatability
- **As threats evolve, exclusively gathering empirical data is no longer feasible**

# Why talk about Jell-O?

- Can't always talk as openly about threats as we'd like
  - I'd really like to talk about how to specify a MATERIAL-X detector
- Jell-O is a convenient short-hand
  - Looks sufficiently like certain threats, depending on properties
  - A solution to specification for Jell-O will probably work for real threats
  - Looks like other stuff that one might find in luggage (e.g., toiletries)
  - Can mix in other stuff for texture / inclusions
  - Moldable and easily containerized
- Easily synthesized to validate that specification works
- **There's always room for Jell-O!**

# What needs to be specified?


- What is Measured?
  - Quantity: Mass and Volume
  - Measuring technology
  - Physical Characteristics
    - Density, $Z_{eff}$, etc. (whatever those mean)
    - Variability tolerances (min, max)
    - Change over time
  - Presentation
    - Critical dimensions (min & max), including shape
    - Contiguousness
    - Concealment
    - Containerizability
    - Homogeneity

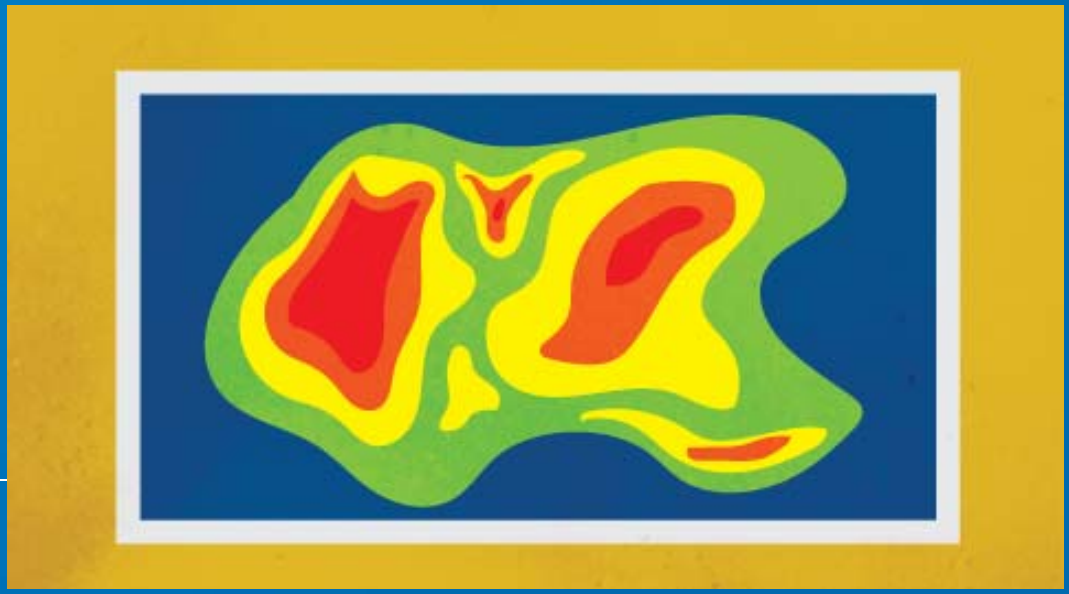
# Measured is not the same as Measurable

- Do I care that Jell-O can be red, green, or blue?
- **Key Observation: Specification informed by detection technology**
  - **Vicious cycle of specification and potentially stifles innovation**

- But wait, there's more!
  - Homogeneity
    - Interior versus surface
  - Do Homemade and Commercial Jell-O differ?
  - Detection expectation ($P_D$)
    - Is all Jell-O considered equal?
  - Distribution across the domain
    - Even a few characteristics lead to an intractable problem

# The distribution problem

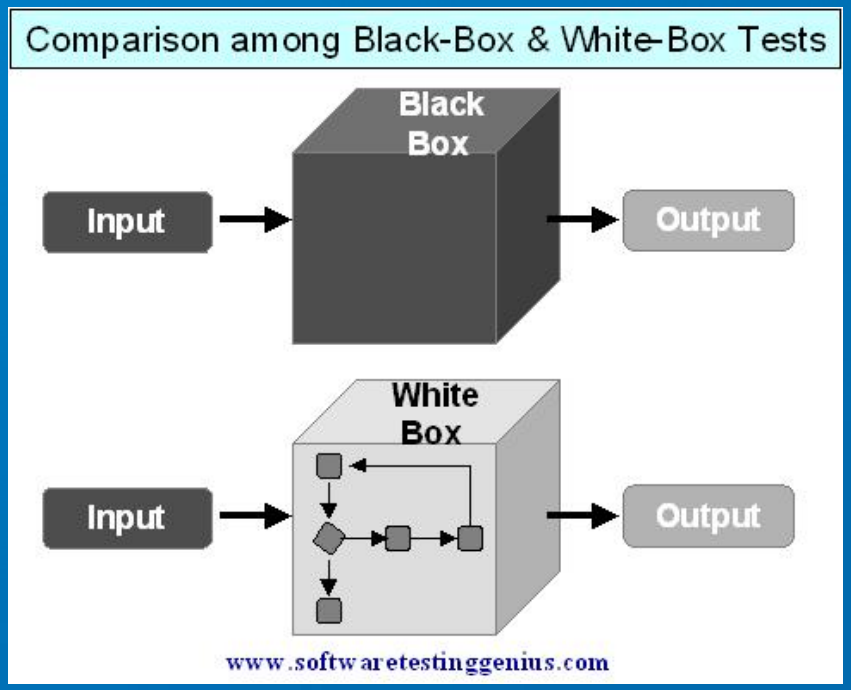
- Imagine two features
  - Let's call them "ρ" and "Z"
- Jell-o has a min & max for those features
  - Does not imply that all possible combinations are viable
  - Does not imply that all possible combinations are equally likely
- Need an n-dimensional "heat map"
  - **Testing should reflect heat map**
  - Don't test the borders to validate the region
- May need sub-regions
  - How many? (2 / 3 / 4)
- Gets messy fast



# Other implications

- Having a specification enables a mix of white-box ("in the know") and black-box ("in the dark") testing
  - Black-Box: based on problem specification
  - White-Box: based on solution approach

Enables the creation of "legitimate" simulants that follow the spec
Customers include vendors and validators



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# Some More Issues

- Can we know what isn't specified?
- How do we ensure robustness?
  - Could be easier, could be much harder
- How do we mix analytical and empirical data?
- How do we focus the lens of different acquisition devices?
- Does this stifle technological creativity?
- Must the specification be entirely physics/chemistry based?
- How do we keep the recipe from becoming too sensitive?

- So… can it be done?
- Academics needed: solve the characterization problem!
  - Need something simple
  - If it doesn't work for Jell-O, it won't work for HMEs