

Julia in Academia

TEXTBOOKS, STANFORD COURSES, AND THE FUTURE

The book cover features a dark background with a blue horizontal bar at the bottom. The title 'ALGORITHMS FOR VALIDATION' is centered in white capital letters. Below the title, the authors' names are listed: MYKEL J. KOCHENDERFER, SYDNEY M. KATZ, ANTHONY L. CORSO, and ROBERT J. MOSS.

92 CHAPTER 4. PREDICTION THROUGH OPTIMIZATION

Figure 4.3 A comparison of optimization-based localization on a 10x10 grid. The top row shows the true objective and the likelihood function for the first iteration of a population-based optimization algorithm, which will be discussed in the next section. The shaded gray path on the plate is the ground truth trajectory, and the most likely path of the system. The bottom row shows the same algorithm that quickly moves towards the objective. A red dot indicates a failure that stays close to the nominal path, while moving toward the obstacle at the end.

ROBERT MOSS, PHD
STANFORD UNIVERSITY | JULIACON 2025

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WHOAMI

WHOAMI



Recent Stanford PhD Graduate
Used Julia throughout my research

WHOAMI



A video thumbnail featuring a man in a grey shirt and khaki pants standing in front of a chalkboard, gesturing with his hands. The thumbnail is framed by a blue border. Below the thumbnail, the text reads "Robert Moss" and "Using Julia as a Specification Language for the Next-Generation Airborne Collision Avoidance System". To the left of the thumbnail, the Julia logo and "JuliaCon 2015" are visible.

Prev. at MIT Lincoln Laboratory
Julia as a specification language

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A video thumbnail from JuliaCon 2015. It shows a man in a grey shirt and khaki pants standing at a podium, gesturing with his hands. The background includes a chalkboard and a wooden panel. The thumbnail has a blue border. Below the thumbnail, the text reads: "Robert Moss" and "Using Julia as a Specification Language for the Next-Generation Airborne Collision Avoidance System".

Prev. at MIT Lincoln Laboratory
Julia as a specification language

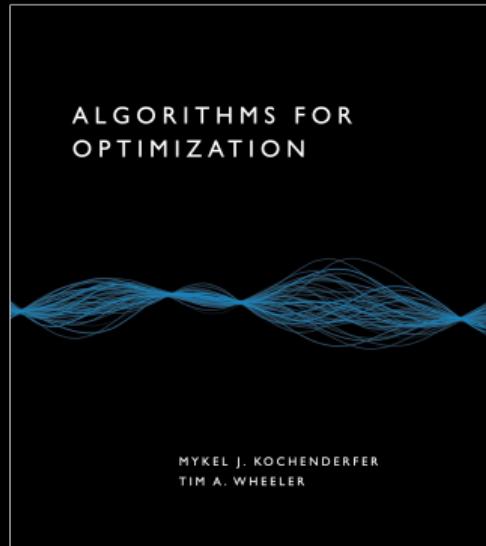
ALGORITHMS FOR VALIDATION

MYKEL J. KOCHENDERFER
SYDNEY M. KATZ
ANTHONY L. CORSO
ROBERT J. MOSS

Textbook Co-Author/Head TA
Algorithms written in Julia

TEXTBOOKS USING JULIA

TEXTBOOKS USING JULIA



Algorithms for Optimization
MIT Press, 2019

TEXTBOOKS USING JULIA

ALGORITHMS FOR
OPTIMIZATION



MYKEL J. KOCHENDERFER
TIM A. WHEELER

ALGORITHMS FOR
DECISION MAKING



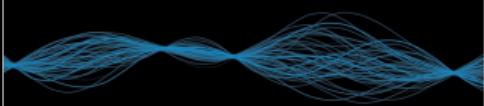
MYKEL J. KOCHENDERFER
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Algorithms for Optimization
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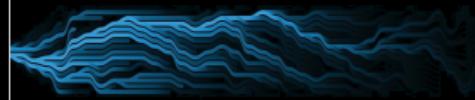
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All PDFs available for free at <https://algorithmsbook.com>

JULIACON 2019



The slide features a white background with a purple footer bar at the bottom. In the center, there is a video frame showing a presentation. The video frame has a white header bar with the JuliaCon Baltimore 2019 logo. The main content of the video frame shows a man standing at a podium with a laptop, speaking to an audience. To the right of the video frame, there is a caption with the speaker's name and affiliation.

HOW WE WROTE A TEXTBOOK USING JULIA
CODE, CONTENT, AND TOOLING

TIM WHEELER
JULY 2019

Tim Wheeler
Kitty Hawk

How We Wrote a Textbook using Julia
Tim Wheeler, JuliaCon 2019

TEXTBOOKS WITH INTEGRATED JULIA

TEXTBOOKS WITH INTEGRATED JULIA

§8 CHAPTER 4: FALSIFICATION THROUGH OPTIMIZATION

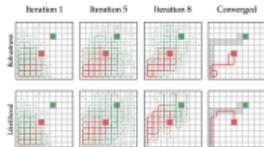


Figure 4.3. A comparison of optimization-based falsifications on the grid world using the robustness objective and the weighted robustness objective. The plots show the progression of the search space for the optimization algorithm, which will be discussed in the next section. The first three columns in each grid in the final column represents the search space for the robustness objective. The weighted robustness objective finds failures that quickly move towards the obstacles. The robustness objective finds a failure that stays close to the target and only moves toward the obstacles at the end.

issues, other objective functions may lead to the discovery of more likely failures in practice.

Another common objective for most likely failure analysis is

$$f(\tau) = p(\tau, \eta) - \lambda \log(p(\tau)) \quad (4.8)$$

where λ is a weighting parameter selected by the user (algorithm 4.10). This objective is search and converges the optimization algorithm to search stimulus ready for trajectories that are both likely and close to failure.

```
function weighted_likelihood_objective(x, xref, w1, smoothness, d, N, 2-1.0)
    y = zeros(N, 1)
    c = rollnorm(xref, x, d)
    x = [x; ones(1, N - length(x))]
    p = logpdf(mvnrnd(xref, w1 * eye(N)), x)
    return smoothness(x, xref, w1, smoothness) - d * log(pdf(x, c))
end
```

4.6 Optimization Algorithms

We can search for failures by applying a variety of optimization algorithms to the optimization problem in equation (4.5).⁴ Algorithm 4.11 implements

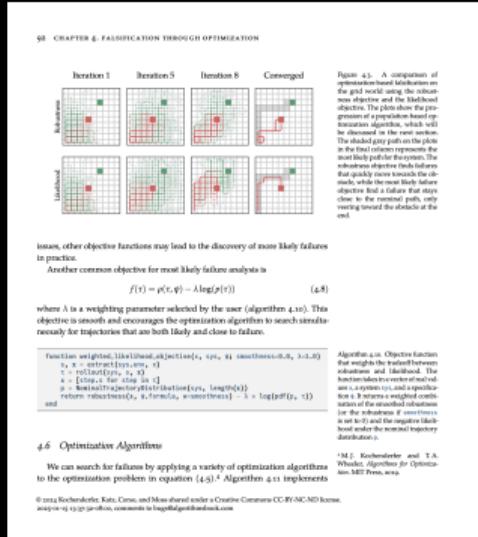
© 2012 Kochenderfer, Kate, Corra, and Mooney under a Creative Commons CC-BY-NC-ND license.
aaron-01-13-12-jarrell, comments to log@jaguar1.us

Algorithm 4.11. Objective function that weights the robustness between solutions and likelihood. The function takes a solution x , a reference solution x_{ref} , a weight w_1 , a smoothness parameter d , a dimension N , a weighting parameter λ , a trajectory c , and a specification \mathcal{I} . It returns a weighted combination of the robustness and likelihood for the solutions if x converges to a failure. If it does not converge, it returns a failure based on the normal trajectory distribution.

⁴M. J. Kochenderfer and T.A. Wheeler, *Algorithms for Optimization*. MIT Press, 2020.

Algorithms for Validation Figures and Julia code

TEXTBOOKS WITH INTEGRATED JULIA



Algorithms for Validation
Figures and Julia code

```
struct ImportanceSamplingEstimation
    p # nominal distribution
    q # proposal distribution
    m # number of samples
end

function estimate(alg::ImportanceSamplingEstimation, sys, ψ)
    p, q, m = alg.p, alg.q, alg.m
    ts = [rollout(sys, q) for i in 1:m]
    ps = [pdf(p, τ) for τ in ts]
    qs = [pdf(q, τ) for τ in ts]
    ws = ps ./ qs
    return mean(w * isfailure(ψ, τ) for (w, τ) in zip(ws, ts))
end
```

Example algorithm

Importance sampling estimation of failure probability

JULIA INTEGRATED INTO L^AT_EX CODE

```
368 where the weights are  $w_{i,l} = p(x_{t+1}) / q(x_{t+1})$ . These weights are sometimes referred to as importance weights. Trajectories that are more likely under the nominal trajectory distribution have  
higher importance weights.  
369  
370 %begin{algorithm} % importance sampling estimation  
371 %begin{juliaverbatim}  
372 struct ImportanceSamplingEstimation  
373     p # nominal distribution  
374     q # proposal distribution  
375     n # number of samples  
376 end  
377  
378 function estimate(p,q;isproposalSamplingEstimation,sys,v)  
379     b, u = a_bias(b, u), a_bias  
380     rs = [rollout(sys, q) for i in 1:n]  
381     ps = [pdf(p, r) for r in rs]  
382     qs = [pdf(q, r) for r in rs]  
383     ws = ps ./ qs  
384     return mean(ws * isfailure(b, r) for (b, r) in zip(ws, rs))  
385 end  
386 %end{juliaverbatim}  
387 %caption{\texttt{IsProposalSamplingEstimation}} The importance sampling estimation algorithm for estimating the  
probability of failure. The algorithm generates  $\mathcal{N}(v|0)$  samples from the proposal distribution  $\mathcal{N}(v|q)$ . It then computes the importance weights for the samples and applies \texttt{Xref{eq}{is\_estimator}} to compute  
Xref{eq}{is\_estimator}{fail}.  
388 %end{algorithm}  
389  
390 %subsection{Optimal Proposal Distribution}  
391 %label{SectionOptimal_Proposal}  
392 The accuracy and efficiency of importance sampling approaches is highly dependent on the proposal  
distribution. The variance of the estimator in \texttt{Xref{eq}{is_estimator}} is  
393 %begin{equation}  
394 \text{Var}(\text{Estimate}) = \frac{1}{N} \sum_{i=1}^N \left( \frac{p(x_i)}{q(x_i)} - \frac{p(x_i)}{q(x_i)} \right)^2 \text{Var}(q(x_i))  
395 %end{equation}  
396 In general we want to select a proposal distribution that makes this variance low, and the optimal  
proposal distribution is the one that minimizes this variance.  
397  
398 It is evident from \texttt{Xref{eq}{is_var}} that we can achieve a variance of zero when  
399 %begin{equation}  
400 \text{Var}(q(x_i)) = 0 \Leftrightarrow p(x_i) = q(x_i) \forall i \in \{1, \dots, N\}   
401 %end{equation}  
402 This distribution corresponds to the failure distribution  $p_f(v) / q(v)$ . As noted in  
403 \texttt{Xref{char}{failure_distribution}}, computing this distribution is not possible in practice since we often  
do not know the full set of failure trajectories and the normalizing constant  $\int p_f(v) dv$  is the  
quantity we are trying to estimate. Our goal is therefore to select a proposal distribution that is as  
close as possible to the failure distribution.
```

L^AT_EX code example

Integrated Julia code using [pythontex](#)

JULIA INTEGRATED INTO LATEX CODE

```

368 where the weights are  $w_i = p(x_{t+1}) / q(x_{t+1})$ . These weights are sometimes referred to as xtext (importance weights). Trajectories that are more likely under the nominal trajectory distribution have higher importance weights.
369
370 begin(algorithm) % importance sampling estimation
371   begin(JuliaVerbatim)
372     struct ImportanceSamplingEstimation
373       p # nominal distribution
374       q # proposal distribution
375       n # number of samples
376     end
377
378     function estimate(alg:ImportanceSamplingEstimation, sys, q)
379       u, w = alg.u, alg.w, alg.q
380       rs = [(rollout(q, q) for i in 1:n]
381       ps = [pdf(q, r) for r in rs]
382       qs = [pdf(q, r) for r in rs]
383       ws = ps ./ qs
384       ws = ws ./ sum(ws)
385       return measure(w * isfailure(u, r) for (u, r) in zip(ws, rs))
386     end
387   end(JuliaVerbatim)
388   caption(alg:ImportanceSamplingEstimation) The importance sampling estimation algorithm for estimating the probability of failure. The algorithm generates n samples from the proposal distribution q/q( $\cdot$ ). It then computes the importance weights for the samples and applies xref{eq:is_estimator} to compute xref{xtext}(fail).
389   end(algorithm)
390
391   subsection(Optimal Proposal Distribution)
392   label(OptimalProposal)
393   The accuracy and efficiency of importance sampling approaches is highly dependent on the proposal distribution and the variance of the estimator in xref{eq:is_estimator} is
394   begin(OptimalProposal)
395     label(eq_is_var)
396     xtext(Var){what p.xtext(fail)} = xref{t1}(e) * whatbb E[(xtext(ssim(q)/q)) * left(\frac{1}{q}right) * (xtext(ssim(q)/q)) * right]
397     xtext(Var){what p.xtext(fail)} = e(xtext(ssim(q)/q)) * 2 * Var(xtext(ssim(q)/q))
398   end(OptimalProposal)
399   In general we want to select a proposal distribution that makes this variance low, and the optimal proposal distribution is the one that minimizes this variance.
400
401 It is evident from xref{eq:is_var} that we can achieve a variance of zero when
402 begin(Equation)
403   label(eq_optimal_proposal)
404   
$$q^*(x) = \frac{p(x)}{\int p(x) ds} = \frac{p(x)}{\int p(x) ds}$$

405 end(Equation)
406 This distribution corresponds to the failure distribution np(xtext(ssim(q)/q)). As noted in xref{failure_distribution}, computing this distribution is not possible in practice since we often do not know the full set of failure trajectories and the normalizing constant p(xtext(fail)) is the quantity we are trying to estimate. Our goal is therefore to select a proposal distribution that is as close as possible to the failure distribution.

```

LATEX code example
Integrated Julia code using `pythontex`

where the weights are $w_i = p(u_i)/q(u_i)$. These weights are sometimes referred to as `xtext` (importance weights). Trajectories that are more likely under the nominal trajectory distribution have higher importance weights.

Algorithm 7.3. The importance sampling estimation algorithm for estimating the probability of failure. The algorithm generates `n` samples from the proposal distribution `q`. It then computes the importance weights for the samples and applies equation (7.9) to compute `xtext(fail)`.

7.2. IMPORTANCE SAMPLING 147

7.2.2 Optimal Proposal Distribution

The accuracy and efficiency of importance sampling approaches is highly dependent on the proposal distribution. The variance of the estimator in equation (7.8) is

$$\text{Var}[\hat{p}_{\text{fail}}] = \frac{1}{n} \mathbb{E}_{i \sim q(\cdot)} \left[\frac{(p(u_i) I(u_i \in \text{fail}) - q(u_i) p_{\text{fail}})^2}{q(u_i)} \right] \quad (7.10)$$

In general, we want to select a proposal distribution that makes this variance low, and the optimal proposal distribution is the one that minimizes this variance.

It is evident from equation (7.9) that we can achieve a variance of zero when

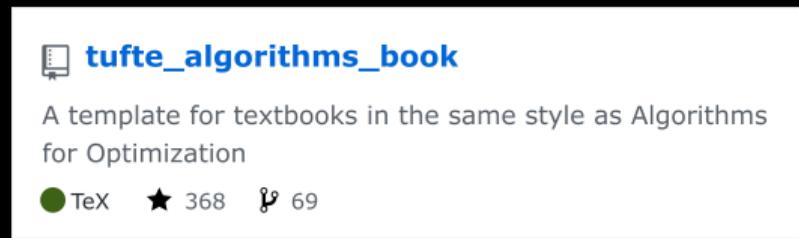
$$q^*(r) = \frac{p(r) I(r \in \text{fail})}{\int p(r) dr} \quad (7.11)$$

This distribution corresponds to the failure distribution $p^*(r) = I(r \in \text{fail})$. As noted in chapter 6, computing this distribution is not possible in practice since we often do not know the full set of failure trajectories and the normalizing constant p_{fail} is the quantity we are trying to estimate. Our goal is therefore to select a proposal distribution that is as close as possible to the failure distribution.

Compiled LATEX PDF
Julia algorithms and LATEX math

OPEN-SOURCE TEXTBOOK TEMPLATE REPOSITORY

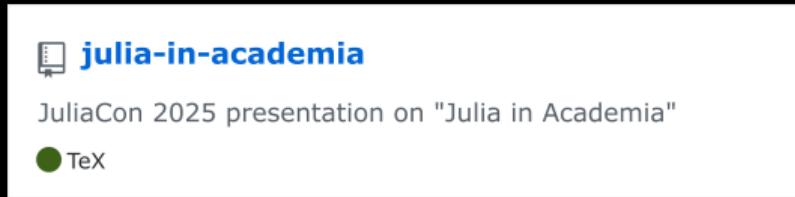
OPEN-SOURCE TEXTBOOK TEMPLATE REPOSITORY



github.com/sisl/tufte_algorithms_book

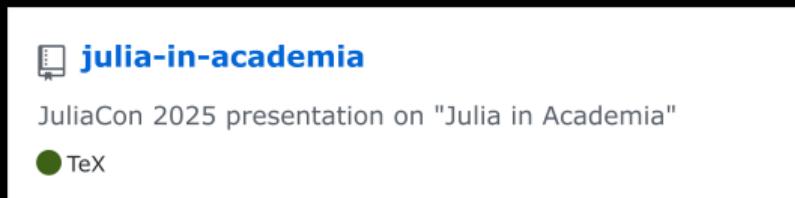
OPEN-SOURCE SLIDES REPO (`BEAMER` + `PYTHONTEX`)

OPEN-SOURCE SLIDES REPO (BEAMER + PYTHONTEX)

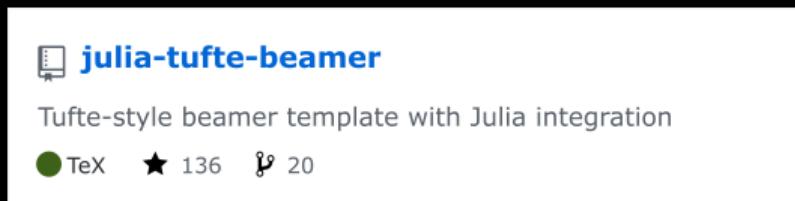


github.com/mossr/julia-in-academia

OPEN-SOURCE SLIDES REPO (BEAMER + PYTHONTEX)



github.com/mossr/julia-in-academia



github.com/mossr/julia-tufte-beamer

JULIA FOR TEXTBOOKS: THE GOOD

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- Concise algorithm descriptions (fits within single page)

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Shout-out to the following packages:

`Distributions.jl`, `LazySets.jl`, `IntervalArithmetic.jl`, `Flux.jl`, `Optim.jl`, and `JuMP.jl`

JULIA FOR TEXTBOOKS: THE NOT-SO-GOOD

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- Somewhat new to readers: Requires learning Julia in the process

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JULIA FOR TEXTBOOKS: THE NOT-SO-GOOD

- Somewhat new to readers: Requires learning Julia in the process
- Potential obscure idioms: broadcasting, anonymous functions, multiple dispatch
- Textbook tooling: Needed to be built out from scratch

JULIA IN THE CLASSROOM

JULIA IN THE CLASSROOM

Stanford University

AA228V/CS238V

Validation of Safety Critical Systems

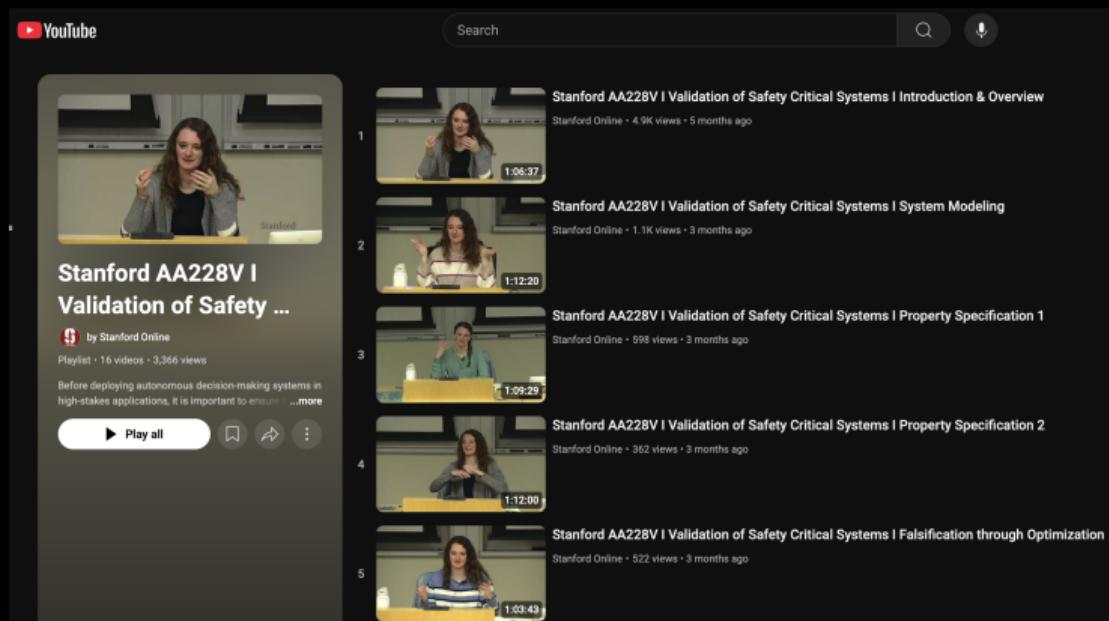
Grad-level course at Stanford

Follows *Algorithms for Validation* textbook

First offered in Winter 2025

LECTURES

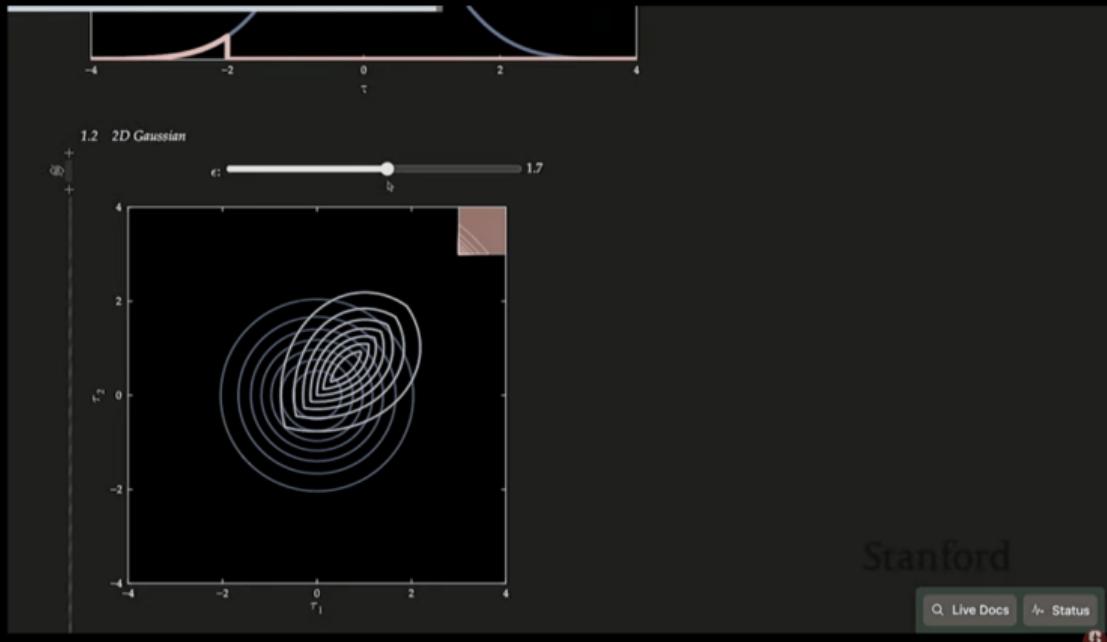
LECTURES



All lectures available on YouTube

Led by Sydney Katz, textbook co-author and award-winning lecturer

INTERACTIVE LECTURES



Interactive lectures using [Pluto.jl](#)

ASSIGNMENTS IN JULIA

ASSIGNMENTS IN JULIA

Stanford AA228V/CS238V Programming Projects

Programming projects for Stanford's AA228V/CS238V Validation of Safety-Critical Systems.

CAS: Failure

CAS: Success

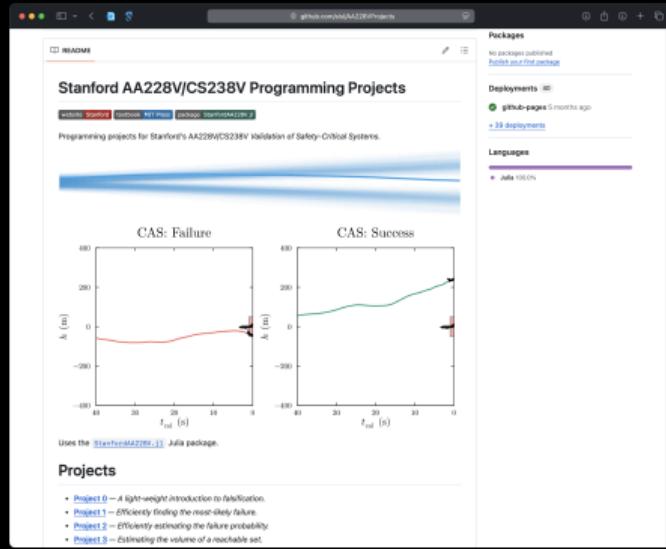
Uses the [StanfordMAster.jl](#) Julia package.

Projects

- Project 0 — A light-weight introduction to telefication.
- Project 1 — Efficiently finding the next-step failure.
- Project 2 — Efficiently estimating the failure probability.
- Project 3 — Estimating the volume of a reachable set.

Assignments repository
Student-facing code

ASSIGNMENTS IN JULIA



Stanford AA228V/CS238V Programming Projects

Programming projects for Stanford's AA228V/CS238V Validation of Safety-Critical Systems.

CAS: Failure

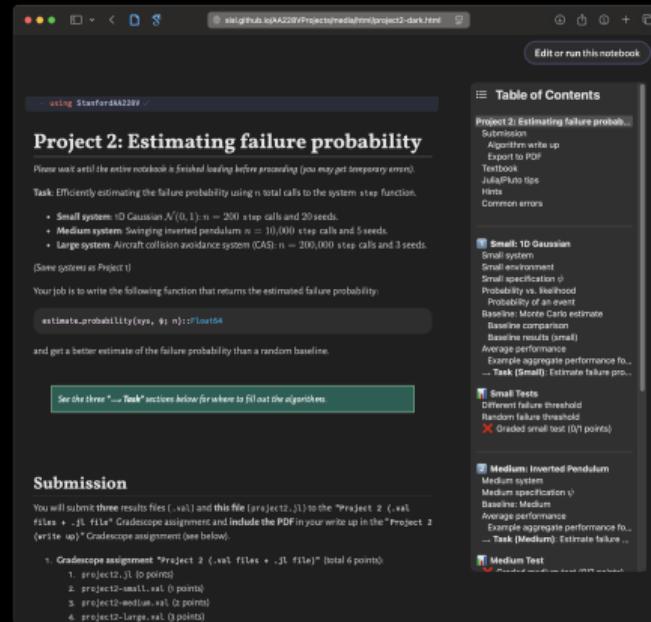
CAS: Success

Uses the [StanfordMATH.jl](#) Julia package.

Projects

- Project 0 – A light-weight introduction to Gradscale.
- Project 1 – Efficiently finding the near-shley failure.
- Project 2 – Efficiently estimating the failure probability.
- Project 3 – Estimating the volume of a macheable set.

Assignments repository
Student-facing code



Project 2: Estimating failure probability

Please wait until the entire notebook is finished loading before proceeding (you may get temporary errors).

Task: Efficiently estimating the failure probability using n total calls to the system step function.

- Small system: 1D Gaussian $\mathcal{N}(0, 1)$; $n = 200$ step calls and 20 seeds.
- Medium system: Swinging inverted pendulum; $n = 10,000$ step calls and 5 seeds.
- Large system: Aircraft collision avoidance system (CAS); $n = 200,000$ step calls and 3 seeds.

(Same system as Project 1)

Your job is to write the following function that returns the estimated failure probability:

```
estimate_probability(ys, ys; n)::Float64
```

and get a better estimate of the failure probability than a random baseline.

See the three “...Task” sections below for where to fill out the algorithms.

Submission

You will submit three results files (.val) and this file (project2.jl) to the “Project 2 (.val files + .jl file” Gradscale assignment and include the PDF in your write up in the “Project 2 (write up)” Gradscale assignment (see below).

Gradscale assignment “Project 2 (.val files + .jl file)” (total 6 points)

- project2.jl (0 points)
- project2-small.val (0 points)
- project2-medium.val (2 points)
- project2-large.val (3 points)

Table of Contents

- Project 2: Estimating failure probability ..
- Submission ..
- Algorithm write up ..
- Export to PDF ..
- TestPlan ..
- JuliaPkgInfo ..
- Hints ..
- Common errors ..

- Small: 1D Gaussian ..
- Small system ..
- Small environment ..
- Small specification ψ ..
- Probability vs. likelihood ..
- Probability of an event ..
- Baseline: Monte Carlo estimate ..
- Baseline comparison ..
- Baseline results (small) ..
- Average performance ..
- Example aggregate performance fo..
- ... Task (small): Estimate failure pro..

- Small Tests ..
- Different failure threshold ..
- Random failure threshold ..
- Created small test (0? points)

- Medium: Inverted Pendulum ..
- Medium system ..
- Medium specification ψ ..
- Baseline: Medium ..
- Average performance ..
- Example aggregate performance fo..
- ... Task (medium): Estimate failure ..

- Medium Test ..

Pluto assignments
Includes local tests

ASSIGNMENTS IN JULIA

The screenshot shows a Pluto notebook interface with the following details:

- Title:** Large Test
- Description:** Will automatically test your most_likely_failure(:largeSystem, s) function below.
- Status:** Graded large test (3/3 points)
- Feedback:** Click to re-run the LargeSystem evaluation.
- Code:** This will re-run most_likely_failure(:largeSystem, s) and re-save project3-large.vat. Uncheck this to load results from the file.
- Table of Contents:**
 - Project 1: Finding the most-likely fail...
 - Submission
 - Algorithm write up
 - Export to PDF
 - Textbook
 - JuliaPluto tips
 - Hints
 - Common errors
- Small: 1D Gaussian:**
 - Small system
 - Small environment
 - Small specification φ
 - Random baseline φ
 - Baselines
 - Baseline results (small)
 - Task (small): Most-likely failure
 - Small Answers
 - Fuzzing
 - Fuzzing Implementation
 - Optimization
 - Optim.jl
 - Optim.jl, Nelder-Mead Implement...
 - (Custom) Gradient Descent
 - (Custom) Gradient Descent Implement...
- Small Tests:**
 - Deadline checker threshold
 - Random failure threshold
 - Slider to control threshold
 - Graded small test (1/1 points)
 - Algorithm for SmallSystem
- Buttons:** Live Docs, Status

Interactive Pluto tests
Get feedback instantly

ASSIGNMENTS IN JULIA

The screenshot shows a Pluto notebook interface with the following details:

- Title:** Large Test
- Description:** We'll automatically test your most_likely_failure(::largeSystem, s) function below.
- Status:** Graded large test (3/3 points)
- Feedback:** Click to re-run the LargeSystem evaluation.
- Text:** This will re-run most_likely_failure(::LargeSystem, s) and re-save project3-Large.vat. Uncheck this to load results from the file.
- Plot:** CollisionAvoidance tests passed! A plot titled "Most-likely failure found" showing position A (m) vs time t_end (s). The plot shows a red curve starting at approximately (-100, -100), rising to a peak around (30, 100), and then falling back towards the end point.
- Text:** You found a passing trajectory!
 $\delta = -97.37071722814194$ (failure log-likelihood)
 $n_{step} = 9.963$ (step calls ≤ 10,000)
- Table of Contents:**
 - Project 1: Finding the most-likely fail...
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 - Hints
 - Common errors
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 - Small: 1D Gaussian
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 - Baselines Small
 - Baseline results (small)
 - Task (Small): Most-likely failure
 - Small Answers
 - Fuzzing
 - Fuzzing Implementation
 - Optimization
 - Optim.jl
 - Optim.jl, Nelder-Mead Implement...
 - (Custom) Gradient Descent
 - (Custom) Gradient Descent Implement...
 - Small Tests
 - Default tolerance threshold
 - Random tolerance threshold
 - Slider to control threshold
 - Graded small test (1/1 points)
 - Algorithm for SmallSystem
- Buttons:** Live Docs, Status

- Separated assignment code from core library ([StanfordAA228V.jl](#))

Interactive Pluto tests
Get feedback instantly

ASSIGNMENTS IN JULIA

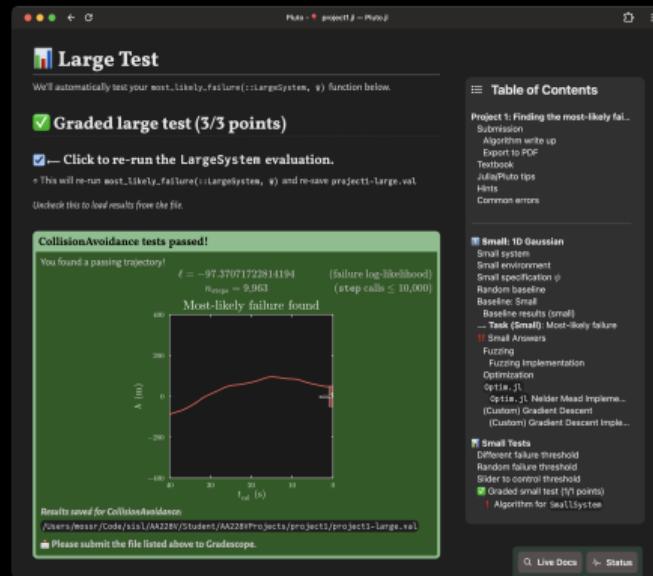
The screenshot shows a Pluto notebook interface with the following details:

- Title:** Large Test
- Description:** Will automatically test your most_likely_failure(::largeSystem, s) function below.
- Status:** Graded large test (3/3 points)
- Feedback:** Click to re-run the LargeSystem evaluation.
- Plot:** CollisionAvoidance tests passed! A plot titled "Most-likely failure found" shows position A (m) versus time t_end (s). The plot shows a red curve starting at approximately (-100, -100), rising to a peak around (30, 100), and then settling near (50, -50).
- Results:** Results saved for CollisionAvoidance
- File Path:** /Users/moser/Code/sis1/AA228V/Student/AA228VProjects/projects/project3/project3-Large.val
- Instructions:** Please submit the file listed above to Gradescope.

- Separated assignment code from core library ([StanfordAA228V.jl](#))
- Local tests exactly match graded tests

Interactive Pluto tests
Get feedback instantly

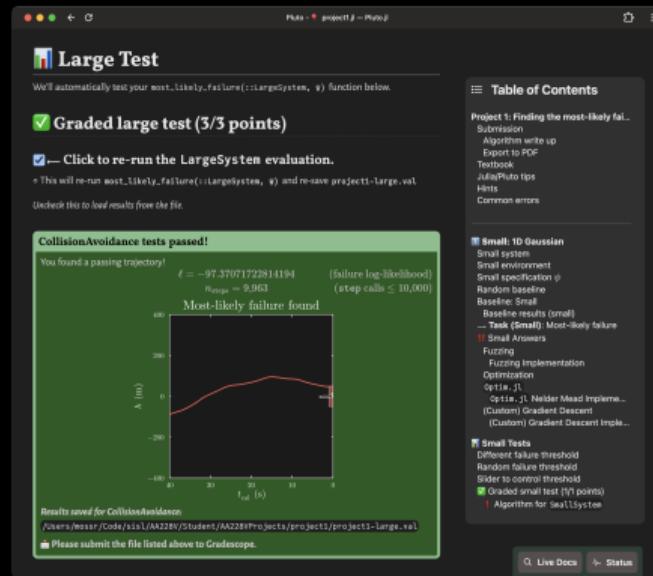
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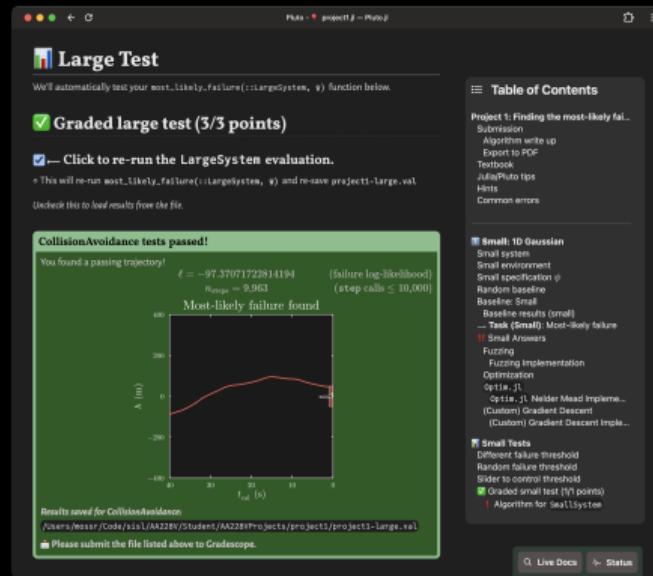
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ASSIGNMENTS IN JULIA



Interactive Pluto tests
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- Separated assignment code from core library ([StanfordAA228V.jl](#))
- Local tests exactly match graded tests
- Interactive nature allows students to play with their algorithms
- No “hidden state” that may confuse students
- Open-source nature requires clever obfuscation of solution code

GRADING ASSIGNMENTS

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The screenshot shows the 'Configure Autograder' page on Gradescope. At the top, there's a navigation bar with three dots, a back arrow, and a forward arrow. The title 'Configure Autograder | Gradescope' is displayed, along with the Gradescope logo.

The main section is titled 'Configure Autograder'. It includes a note: 'Upload your autograder code and change settings here. You can also come back to this step later, but submissions will not be automatically graded until then. Please follow our [guidelines](#) for structuring your autograder.' Below this, there's a note: 'Note: Uploading an autograder zip file will automatically update your Dockerhub image name once it is built successfully.'

There are two radio button options under 'Autograder Configuration': 'Required field' (selected), 'Zip file upload' (selected), and 'Manual Docker configuration' (unchecked).

The 'Autograder' section contains a file input field with the value 'autograder_project1.zip', a 'Replace Autograder (.zip)' button, and a 'Download Autograder' button.

Configuration dropdowns include 'Base Image OS' set to 'Ubuntu', 'Base Image Version' set to '22.04', and 'Base Image Variant' set to 'Base'.

A note below the variants says: 'Choose the [base image](#) that will be used to build your autograder. This determines the operating system version and packages available in your autograder.'

Buttons at the bottom left include 'Update Autograder' and 'Test Autograder' (disabled).

The 'Docker Image Status' section shows: 'built as of Jan 31, 2025 at 8:58:58 PM PST'.

Links for 'Build Output' and 'Build Errors' are present.

At the bottom right is a green button labeled 'Manage Submissions'.

Autograde via Gradescope
Students upload Pluto notebook

GRADING ASSIGNMENTS

The screenshot shows the 'Configure Autograder | Gradescope' page. It includes fields for 'Autograder Configuration' (with 'Zip file upload' checked), 'Autograder (.zip)' (containing 'autograder_project1.zip'), and 'Docker Image Status' (built on Jan 31, 2025). A 'Manage Submissions' button is at the bottom.

Autograde via Gradescope
Students upload Pluto notebook

The screenshot shows the GitHub repository 'Gradescope.jl'. It displays the repository's README, which includes a link to the Gradescope autograder specification. The repository has 7 stars, 2 forks, and 7 watching. It also lists releases, packages, and languages used.

Light-weight **Gradescope.jl** package
Manage deps and create autograders

FUTURE USE OF JULIA IN ACADEMIA

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- Compile Julia code to binaries to avoid obfuscation
- Write interactive research papers in Julia/Pluto

What if we could interact directly with the code in research papers?

Pluto.jl   

[Algorithms for Validation](#)

Lecture Introduction

1 Introduction

Before deploying decision-making options in high-stakes settings, it is important to ensure that they will operate as intended. We refer to the process of analyzing the behavior of these systems as validation. Validation is a critical component of the development process for decision-making systems. As the complexity of the systems increases, so does the complexity of validating them. As these systems and their operating environments increase in complexity, understanding the full spectrum of possible behaviors becomes more challenging and requires a rigorous validation process. This chapter provides an overview of validation methods and challenges specific to validating autonomous systems. This chapter begins with a broad overview of validation. We motivate the need for validation from a historical perspective and outline the societal consequences of validation failures. We then introduce the validation framework that we will use throughout the book. We discuss the challenges associated with validation and conclude with an overview of the remaining chapters in the book.

2 Probability Distributions

The univariate normal distribution.³

$$N(x | \mu, \sigma^2) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left(-\frac{(x - \mu)^2}{2\sigma^2}\right)$$

³ Here is a longer sidebar explaining more things in detail. This could reference links or other material.

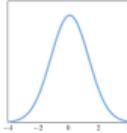


Figure 1. The normal (Gaussian) distribution

$\mu =$ 0.1

$\sigma^2 =$ 1.0

Interactive research papers
Run code directly in the paper

PLUTO PAPERS.JL

Pluto.jl    

Algorithms for Validation

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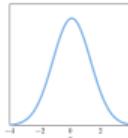
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PlutoPapers.jl

Interactive and LaTeX-styled papers in Pluto.jl

Julia  5

<https://github.com/mossr/PlutoPapers.jl>

Interactive research papers
Run code directly in the paper

THANK YOU!



QUESTIONS?

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