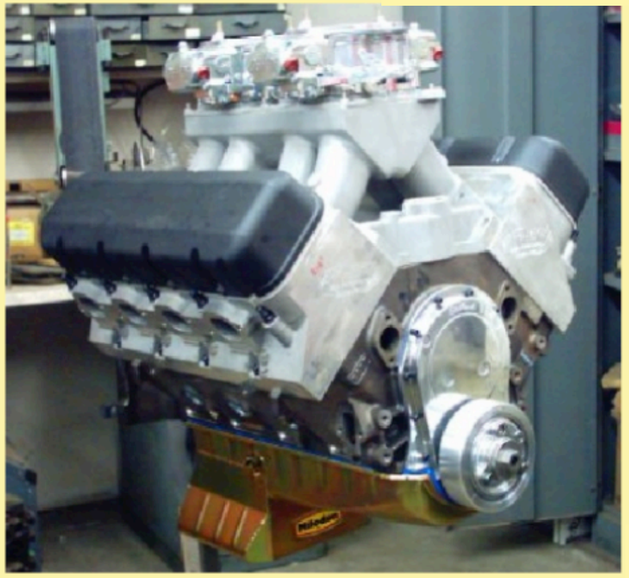
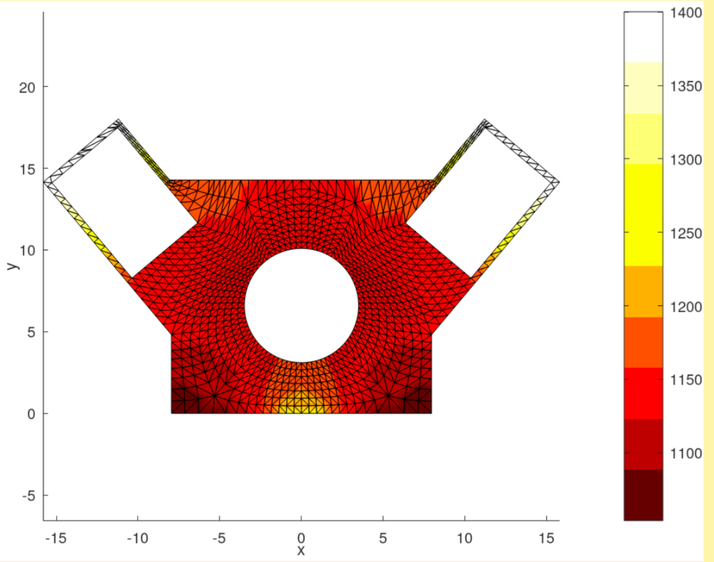
eXTREME MODELING



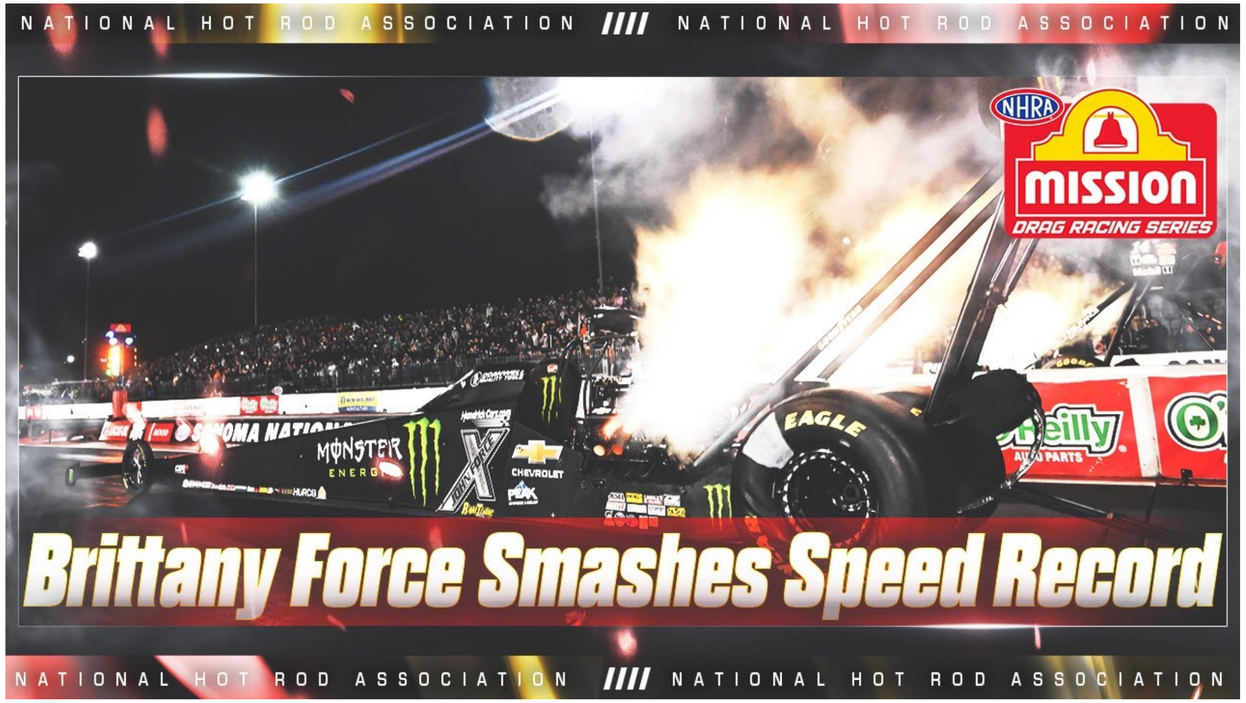


The Situation

Force went 3.704 seconds at 337.33 mph in her 12,000-horsepower Chevrolet Accessories dragster, holding off Langdon's run of 3.727 at 333.91 to pick up her second victory in 2025 and her fifth career win in Las Vegas. Nov 3, 2025

Engine Builder Magazine
https://www.enginebuildermag.com › 2025/11 › brittan...

Brittany Force Becomes Winningest Female in Top Fuel History



https://www.youtube.com/watch?v=2hCkACnJoFM

Critical Safety Assessment for Brittany Force's Championship Race

Introduction

After graduation, you secured a position as Brittany Force's lead mechanical engineer. With the 2025 championship race only two days away, your team has been focused on pushing the performance boundaries of her race car. In pursuit of increased horsepower, your group has been experimenting with a new additive to the nitromethane fuel, aiming for a remarkable 30% power boost.

Engineering Challenge

Despite the promising potential of the new additive, experimental results indicate a significant risk: if temperatures in the crankshaft region of Brittany's Chevy engine block exceed 1500 degrees Celsius, the engine could "throw a rod" (connecting rod), leading to catastrophic failure.

Analysis Setback

To ensure safety, you have relied on finite element method (FEM) software to analyze temperature profiles under these extreme conditions. However, just before the race, the FEM software company you depend on suffered a severe cyber attack, rendering their tools unavailable. With no alternative, you must now develop your own FEM code to determine whether the new additive will cause dangerous temperature spikes.

Leveraging Past Experience

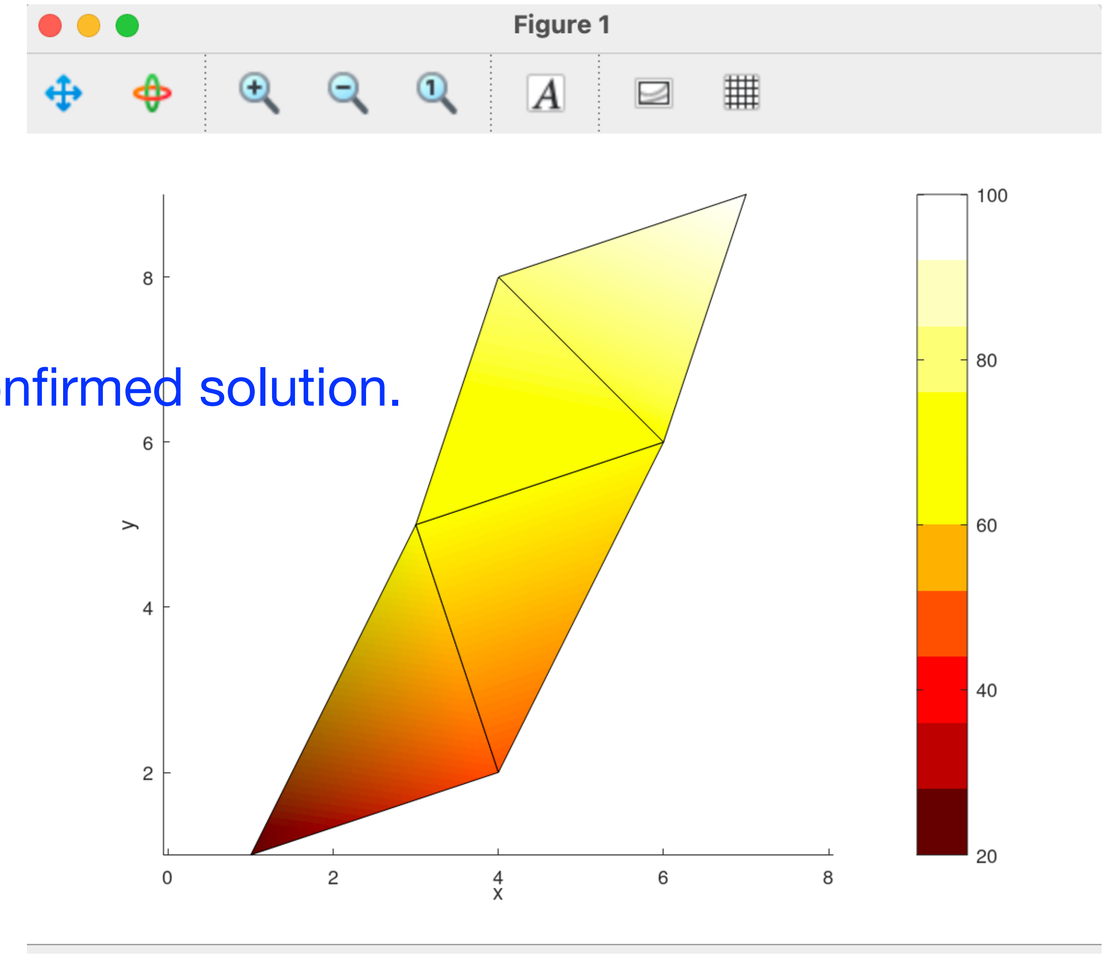
Fortunately, you recall the comprehensive FEM lessons from your professor at Duke. Drawing upon this knowledge, you are prepared to undertake the analysis yourself to protect Brittany and her vehicle.

Cross-Checking Results

Adding to the pressure, a friend—rumored to be assisting the competition—has already provided a temperature profile plot, claiming it accurately represents the results. You hope your independent analysis will confirm these findings, ensuring both Brittany's safety and the integrity of your friendship.

Test geometry for your code.

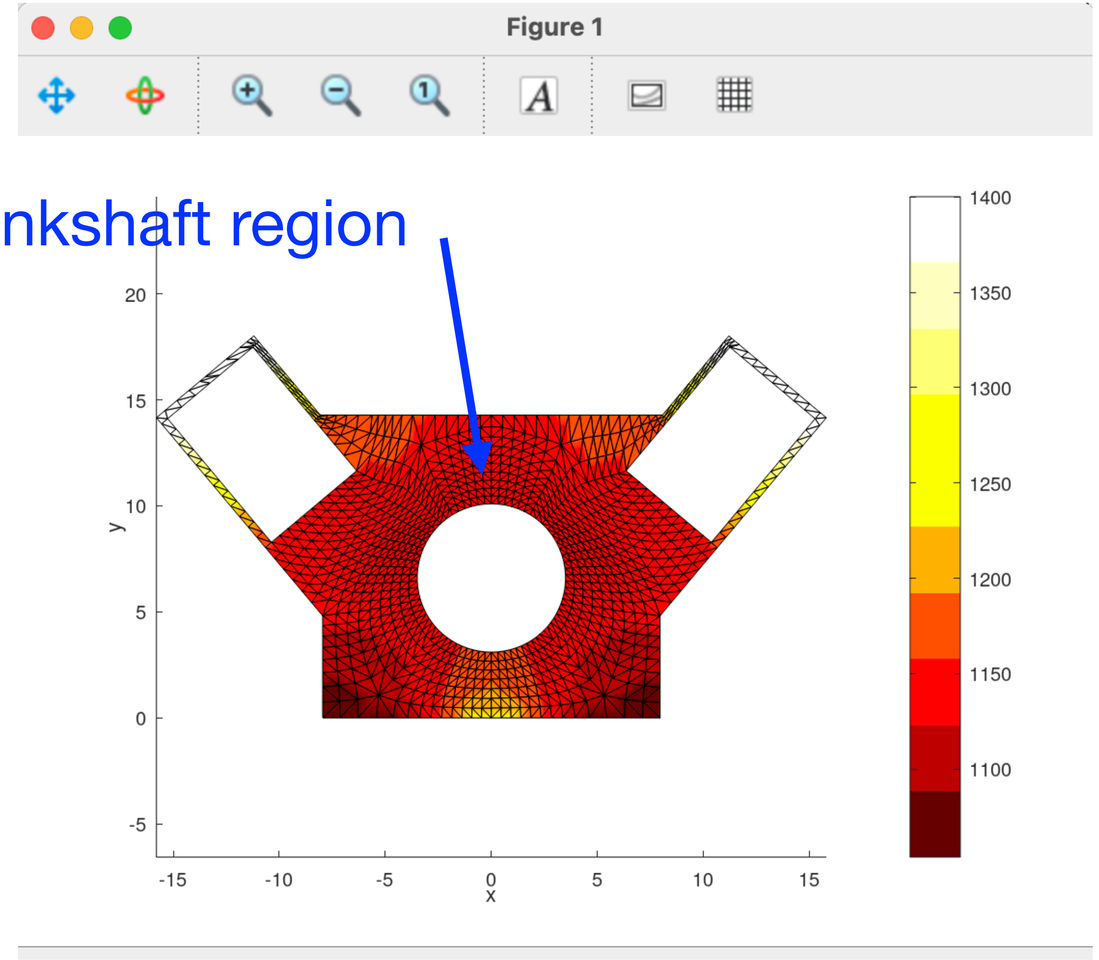
(If your code works for 4 elements it will work for 10,000.)



Solve this first: 20% of grade

(This will take 1 second to appear.)

Your friend's plot.



Solve this second: 80% of grade

(This will take 20 seconds to appear.)

The Assignment

Read the provided FEM implementation document.

Given: (for both the engine and a test problem.)

- Files with the nodes and elements composing the engine's geometry in 2D.
- A file with temperatures expected at various locations (nodes) on the surface of the block.

Write the FEM code.

- First test on the test problem. (Figure 1 in the implementation document.)
- Next, if the test problem is successful, on the engine block.

Feel free to contact your professor for assistance debugging your code.

This is an individual effort — GOOD LUCK!!