

# How Not to Go Boom

## Lessons for SREs from Oil Refineries

Emil Stolarsky | @EmilStolarsky





# Resiliency

A baby with light hair, wearing a pink top and shorts, is seated in a protective cocoon made of crinkled, reflective silver material. To the left of the baby is a yellow duck-shaped stuffed toy with orange beak and feet. The background is a plain, light-colored wall with a large yellow circle and a red circle partially visible on the right side. The word "Resiliency" is overlaid in white, bold, sans-serif font in the center of the image.

WAFFLE  
HOUSE

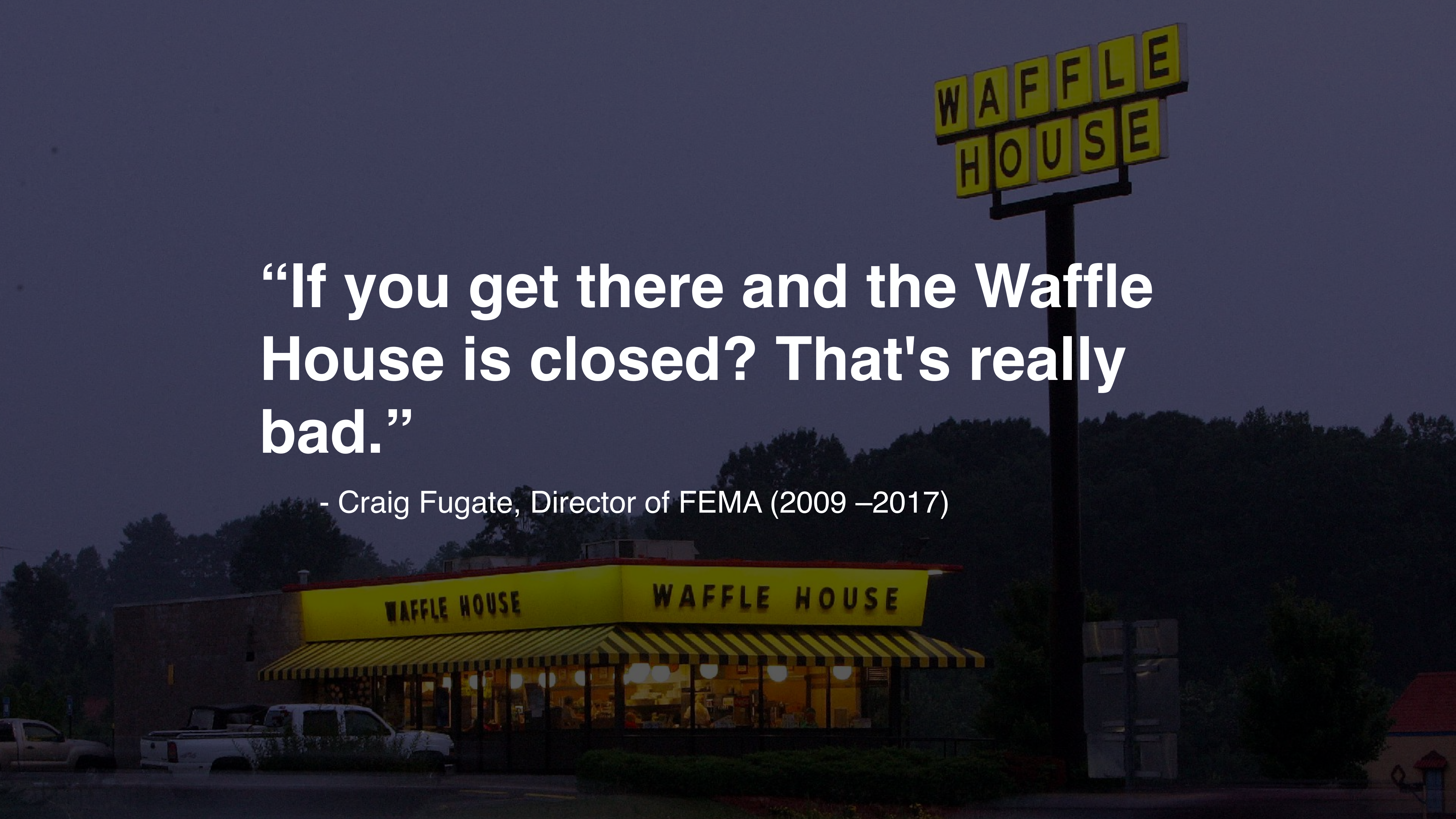
WAFFLE HOUSE

WAFFLE HOUSE



**“If you get there and the Waffle House is closed? That's really bad.”**

- Craig Fugate, Director of FEMA (2009 –2017)




A wide-angle photograph of an oil refinery at night. The scene is filled with a complex network of pipes, walkways, and industrial structures. Numerous tall distillation columns and towers are visible, some with bright lights at their tops. The overall lighting is a mix of cool blues and purples from the twilight sky, and warmer yellows and oranges from the artificial lights within the facility. The foreground shows a dense array of pipes and metal railings, suggesting a high vantage point. The background shows more of the refinery's infrastructure stretching into the distance under a darkening sky.

# Oil Refineries

An aerial photograph of a large industrial refinery or chemical plant. The facility is filled with a complex network of pipes, walkways, and large cylindrical storage tanks. In the center-left, a fire is burning, with bright orange flames and thick white smoke rising. Multiple high-pressure water jets are being directed at the fire from various points, creating large plumes of mist. The overall scene is one of an active industrial emergency response.

# Design for failure

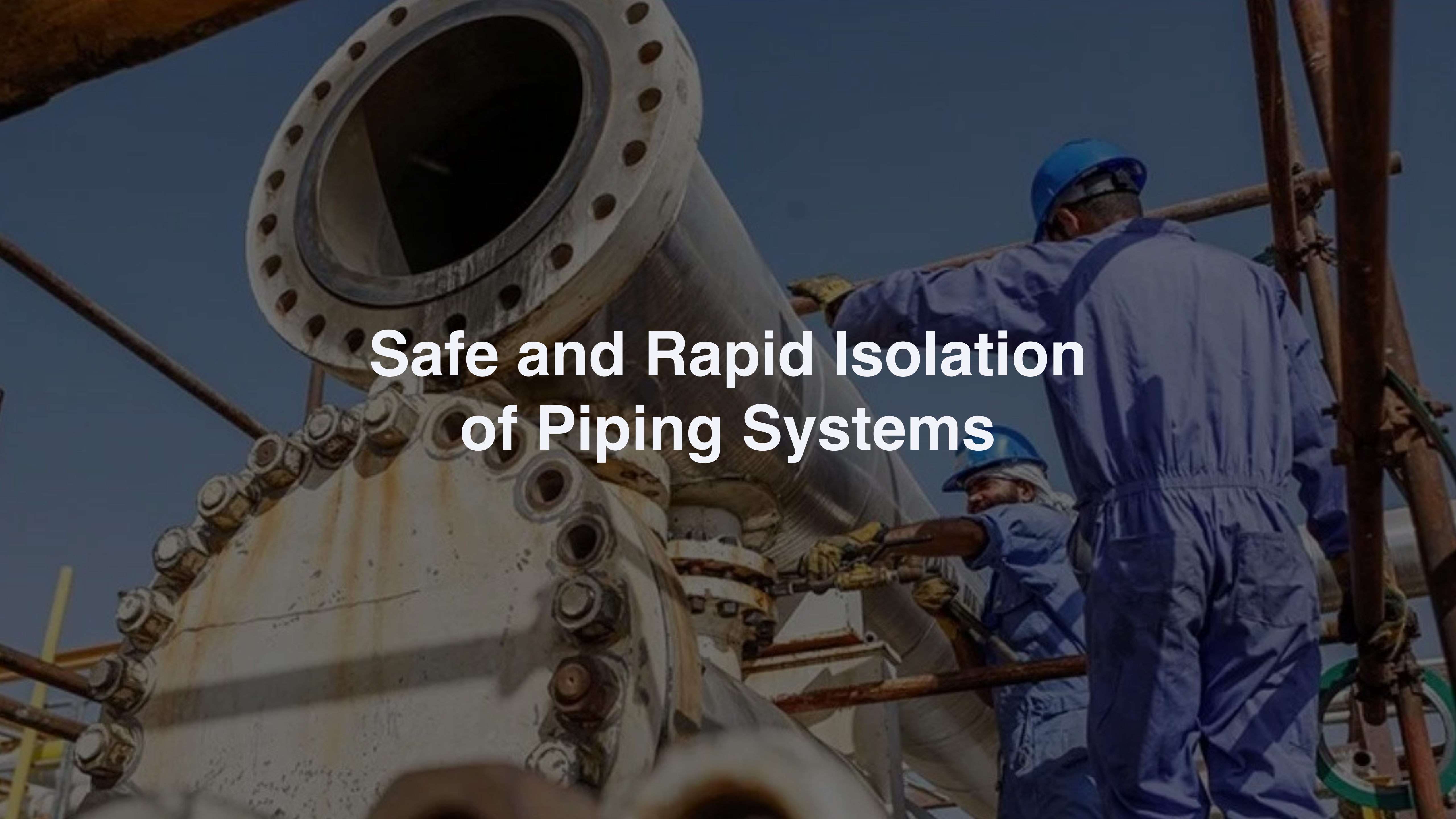


# Explosion Isolation Systems



The image shows a complex industrial piping system, likely part of a pressure relief system. It features numerous white pipes, valves, and gauges. Several large, prominent red handwheels for valves are visible, arranged in a line that recedes into the background. The scene is set outdoors under a clear blue sky, with shadows cast on the ground. The overall image has a semi-transparent dark overlay.

# Pressure Relief Systems

The image shows two industrial workers in blue protective suits and hard hats working on a large, complex piping system. One worker is in the foreground, seen from the back, while the other is further back, working on a section of the pipe. The system features a large, circular, bolted opening at the top. The background is a clear blue sky, suggesting an outdoor industrial setting. The overall scene conveys a sense of industrial maintenance or construction.

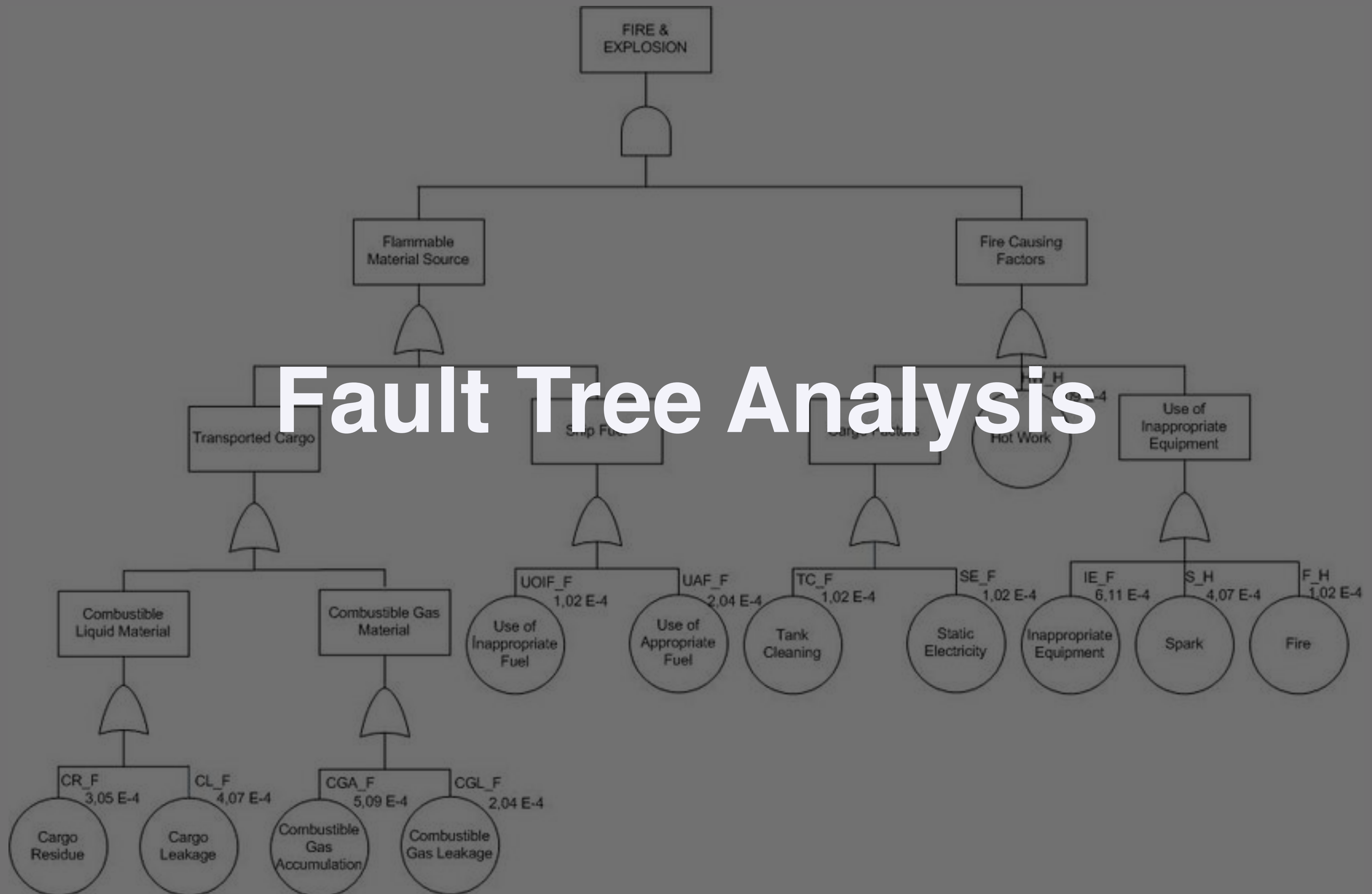
# Safe and Rapid Isolation of Piping Systems

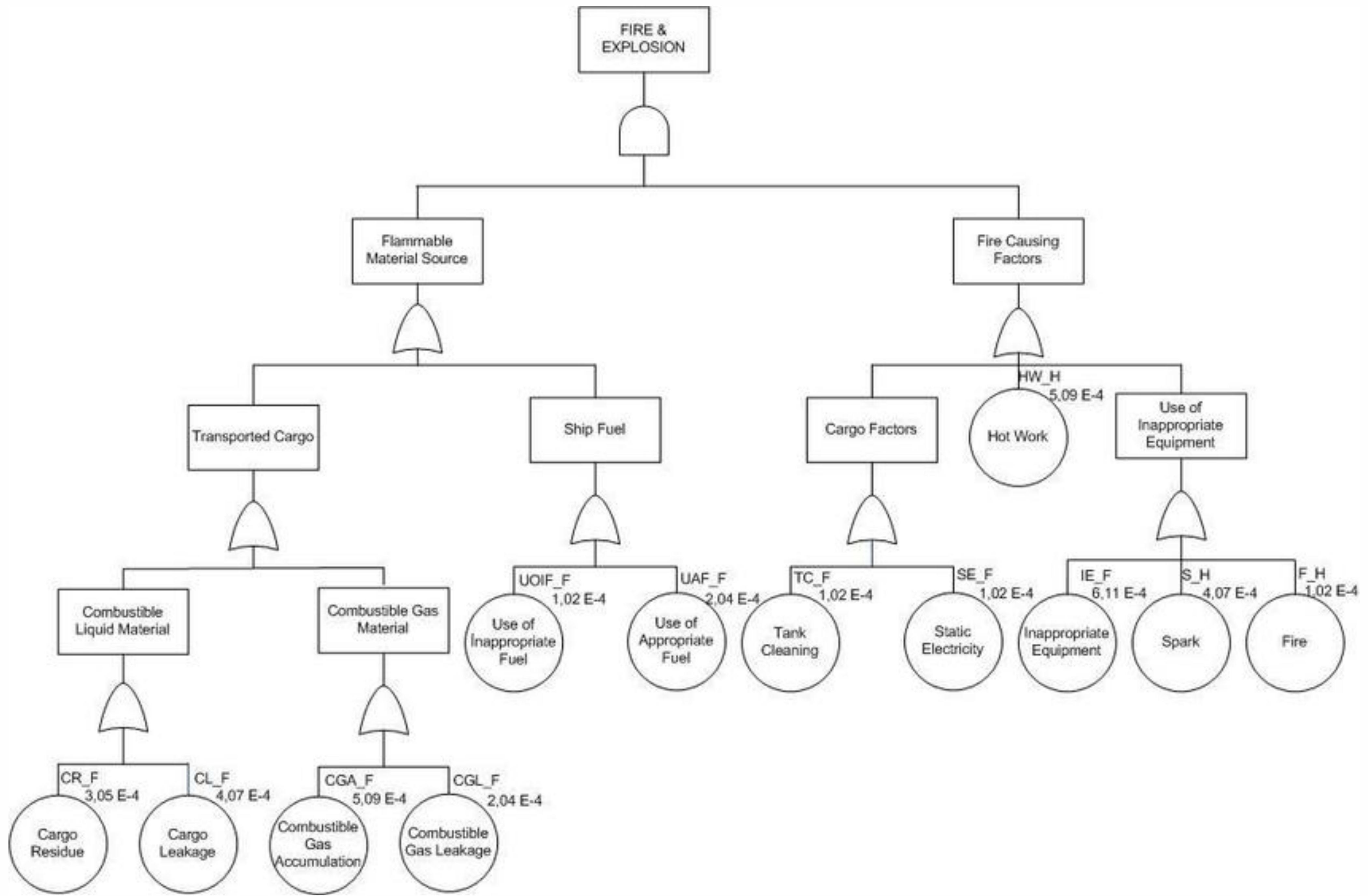


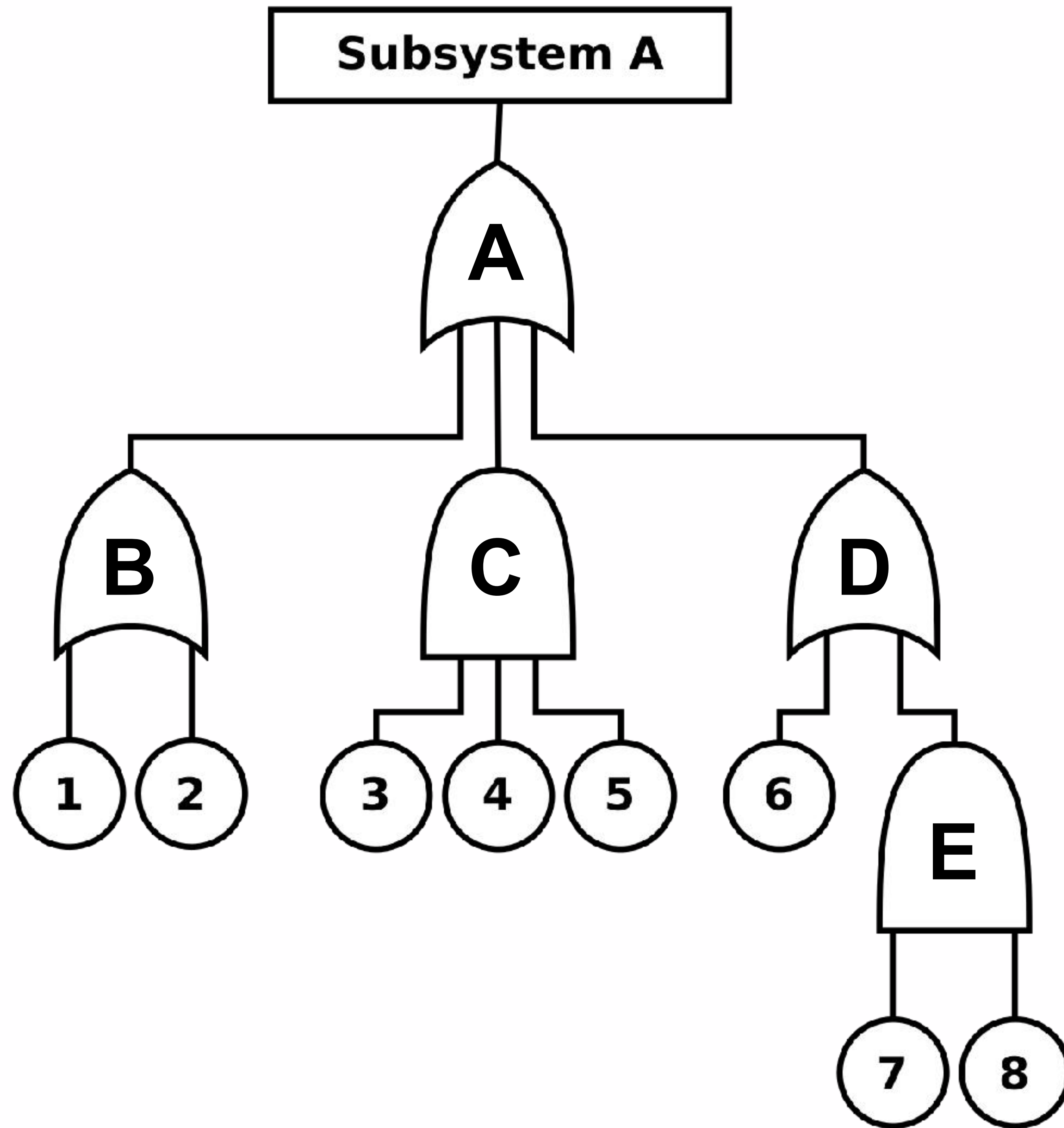
**“If you think safety is expensive,  
try having an accident.”**

- Trevor Kletz, Chemical Process Safety Expert

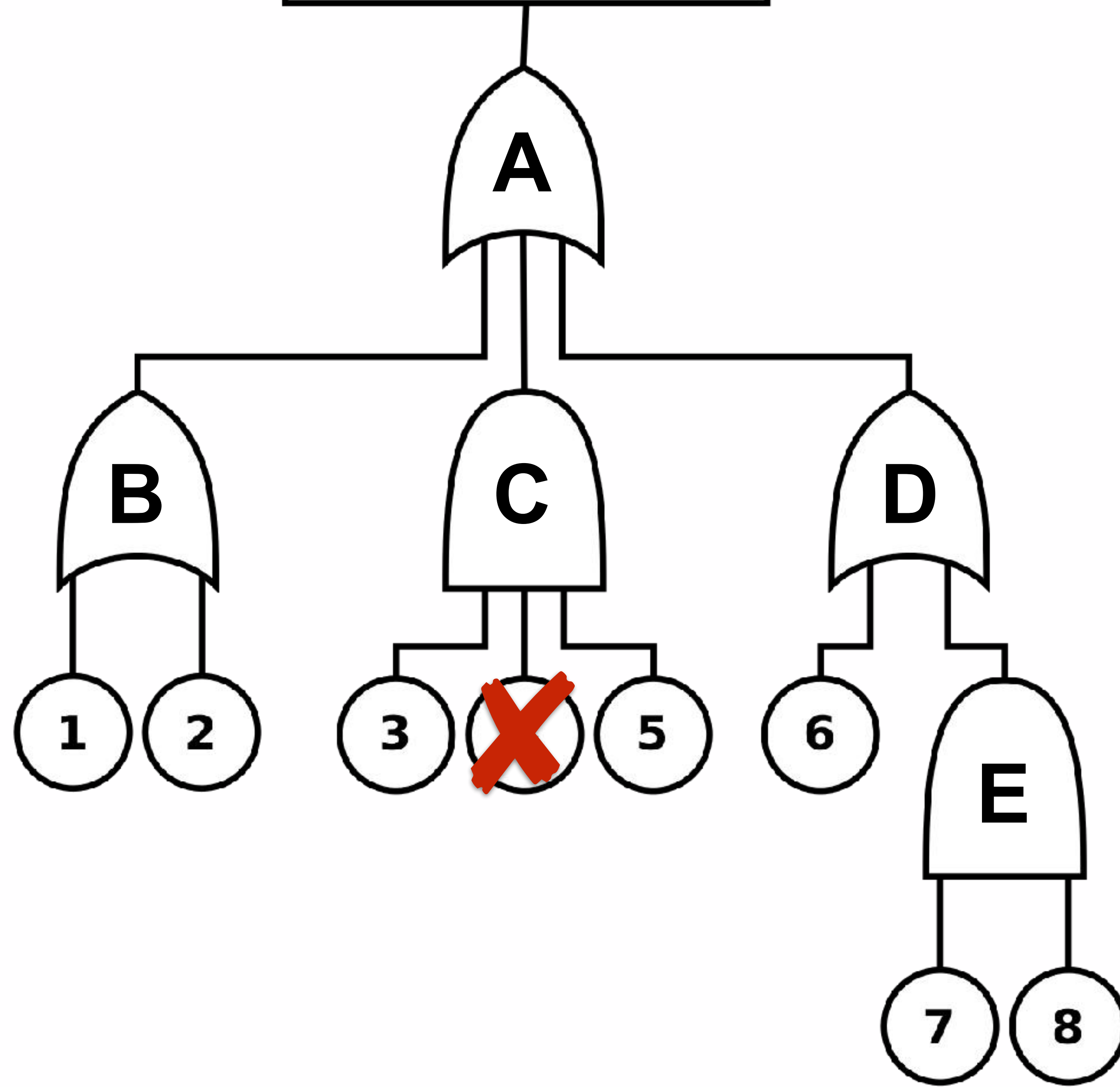
# Fault Tree Analysis



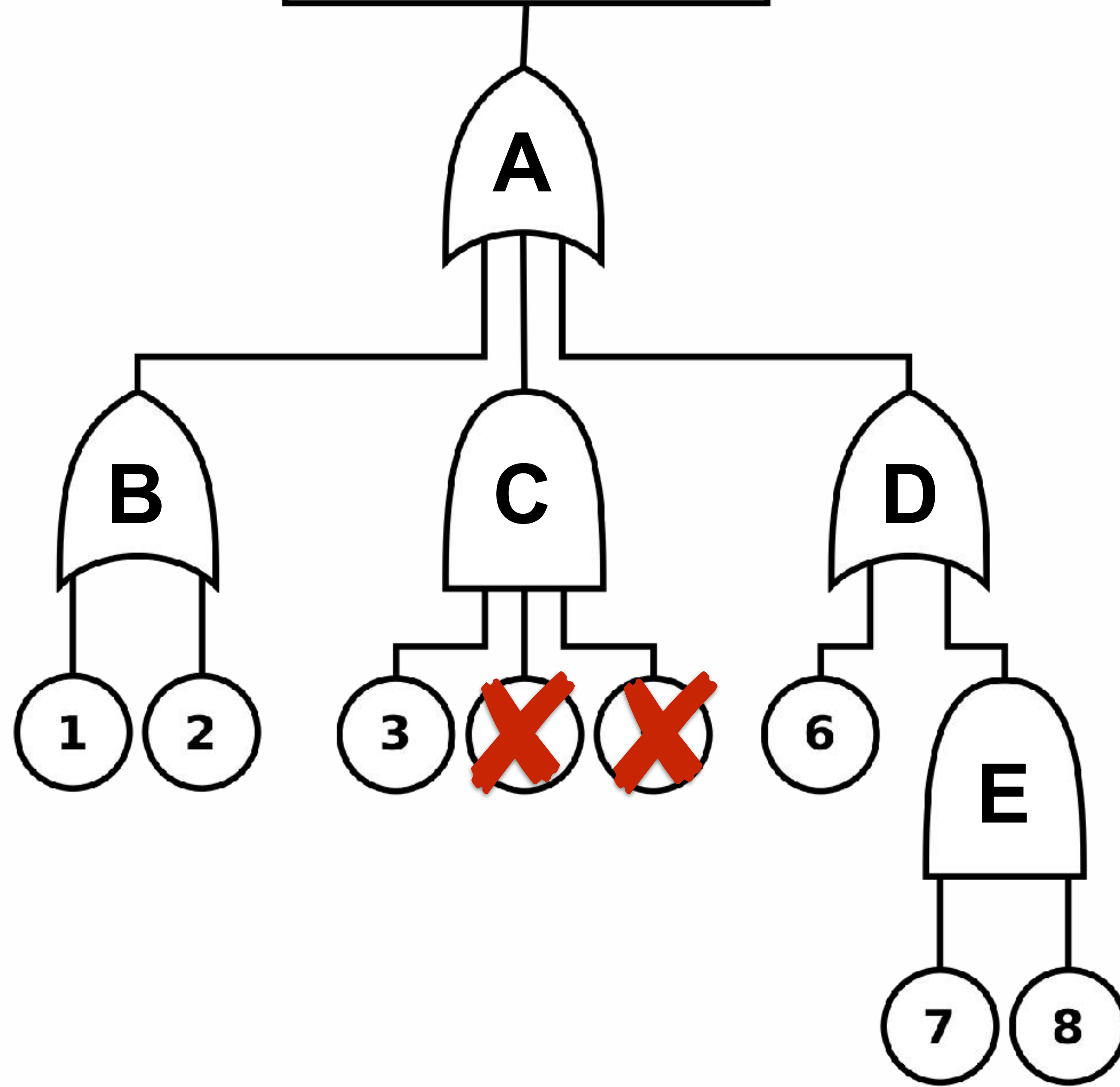




**Subsystem A**

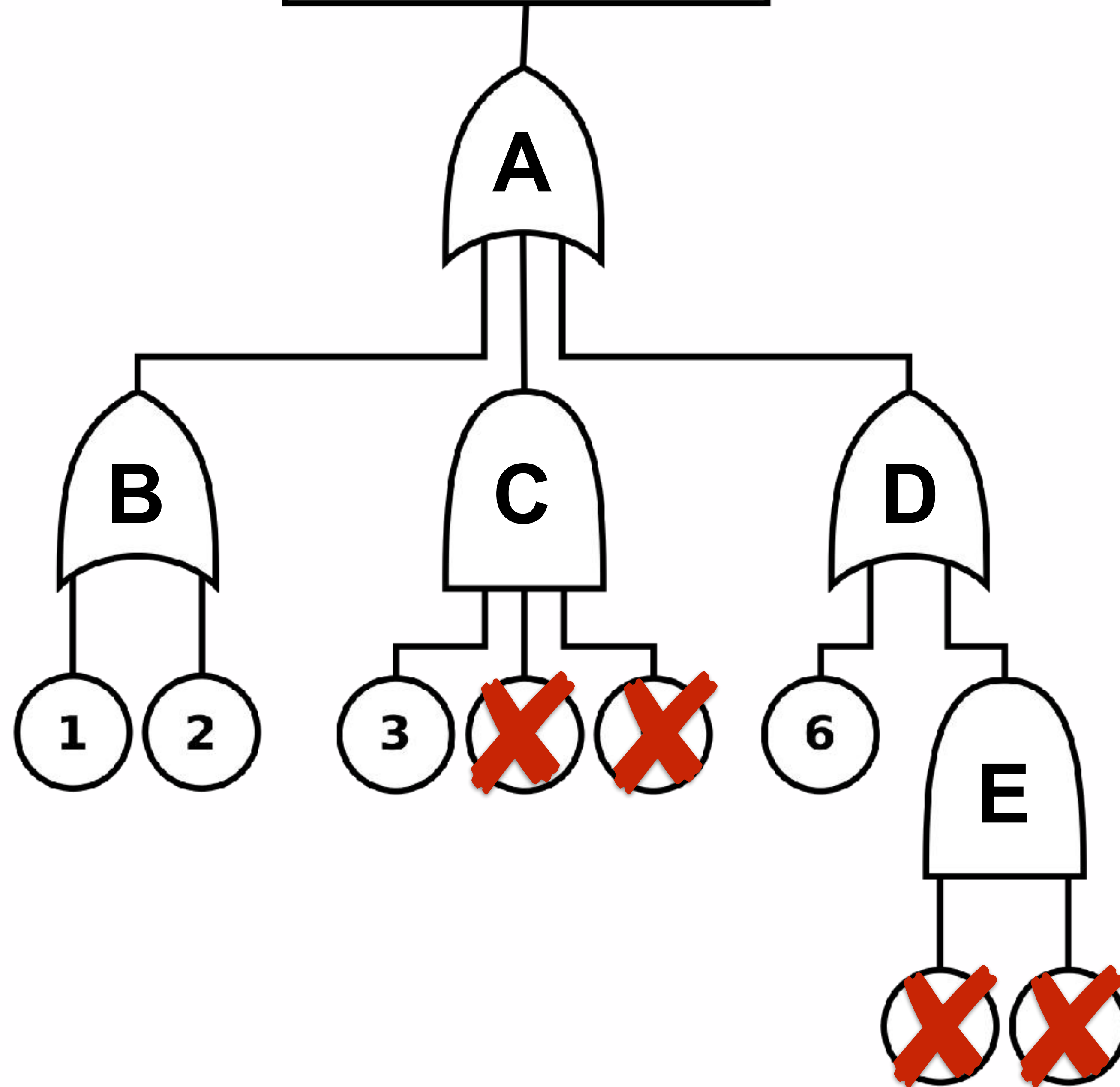


**Subsystem A**

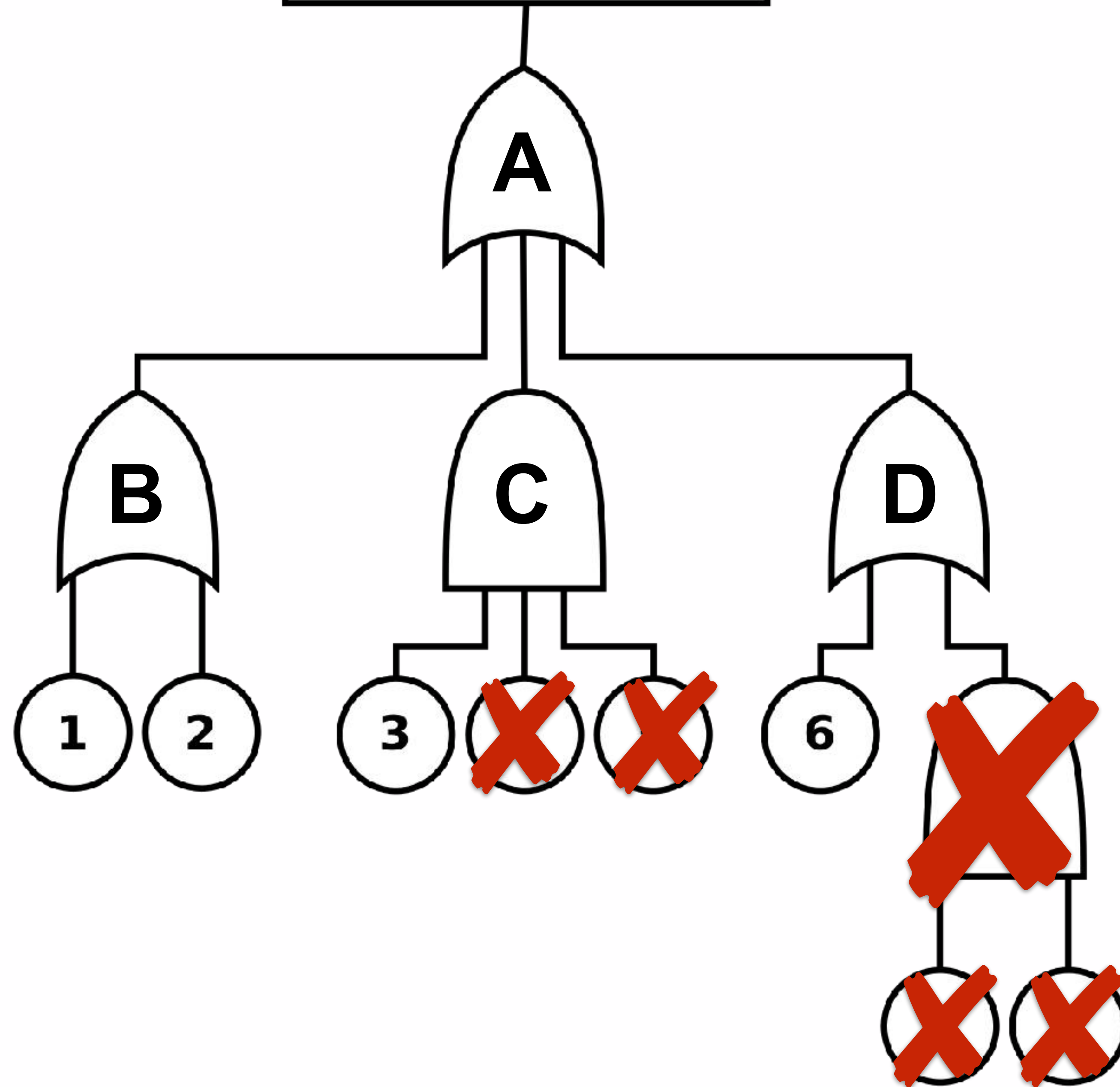




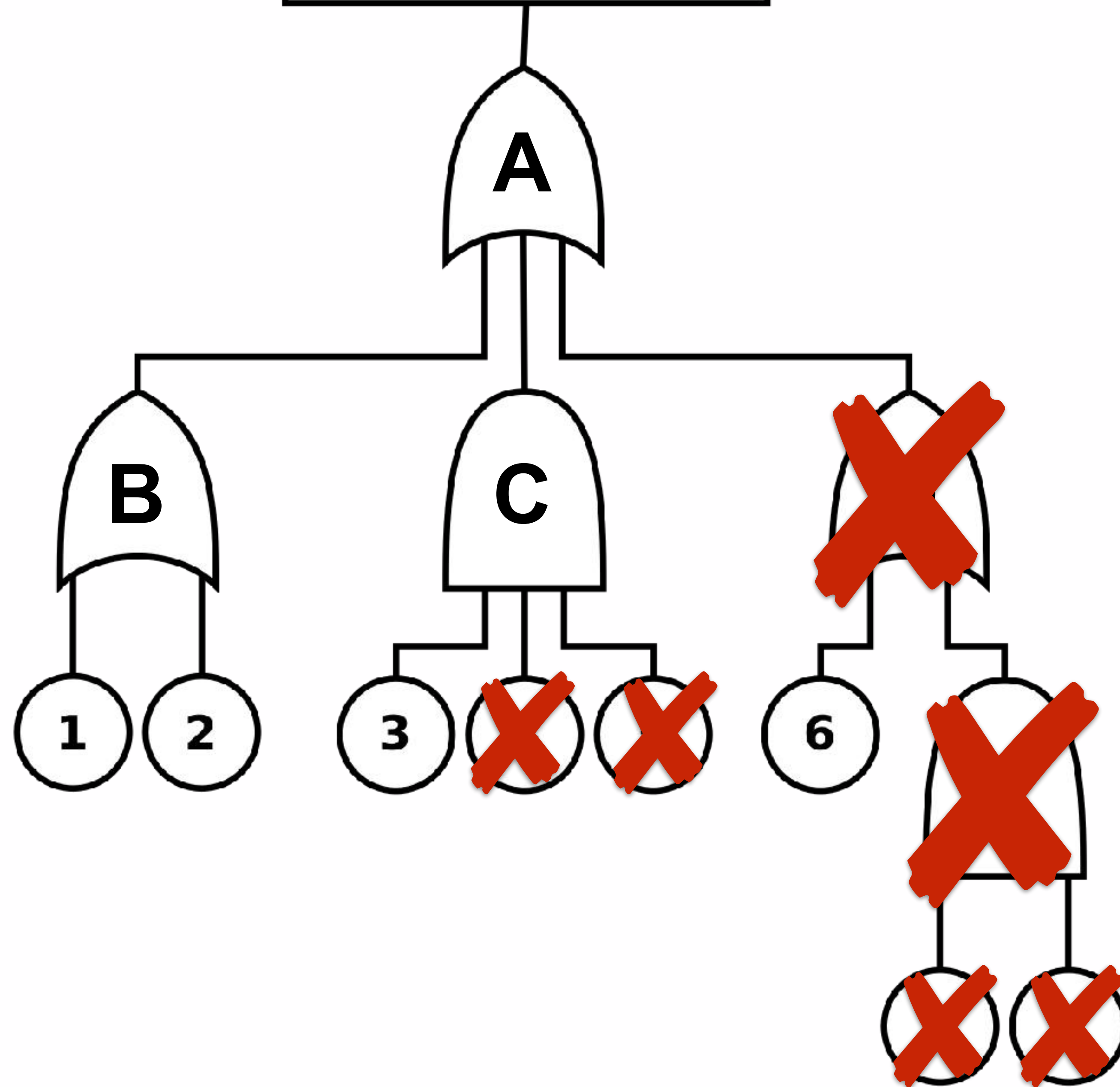
# Subsystem A



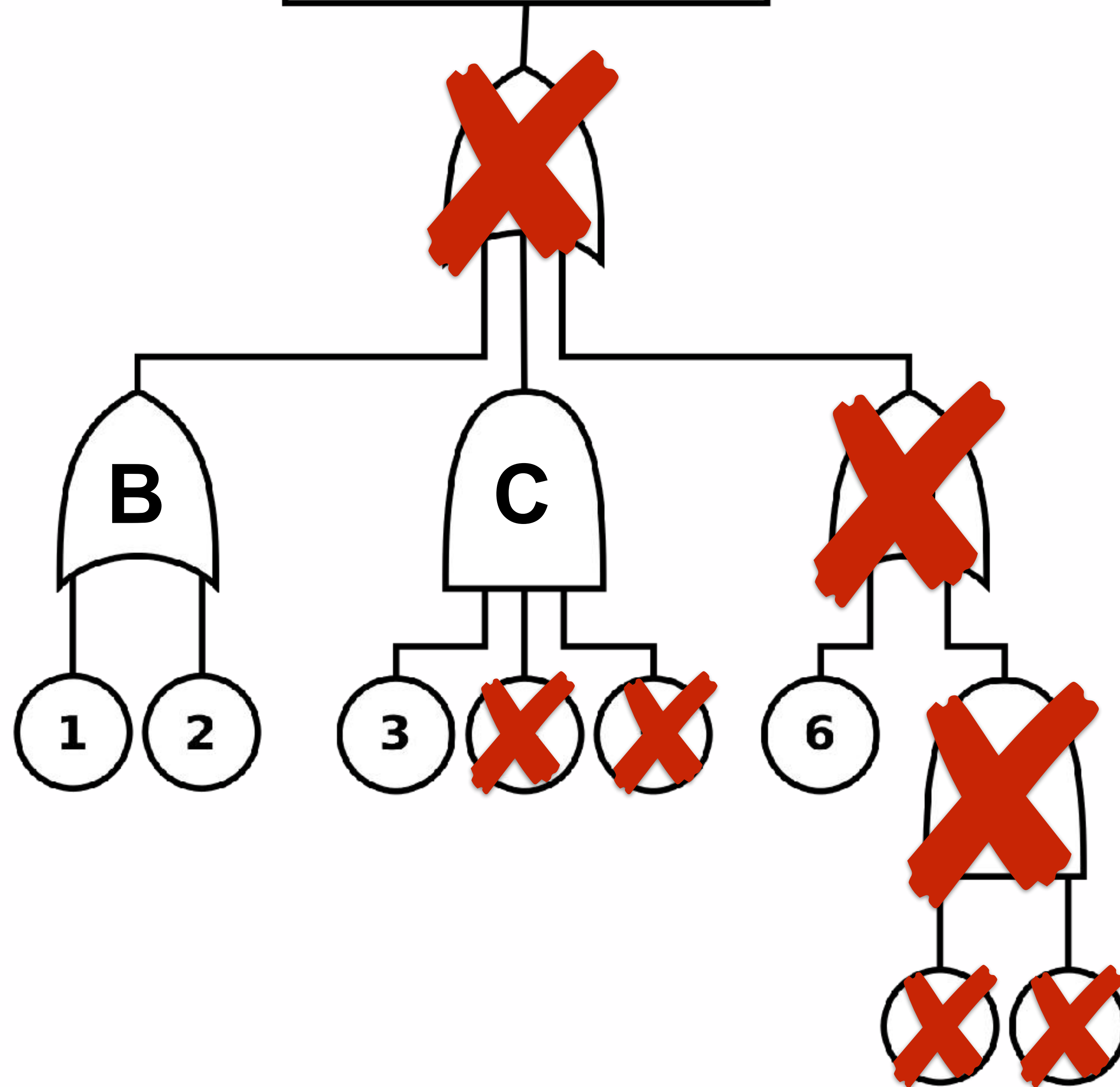
# Subsystem A



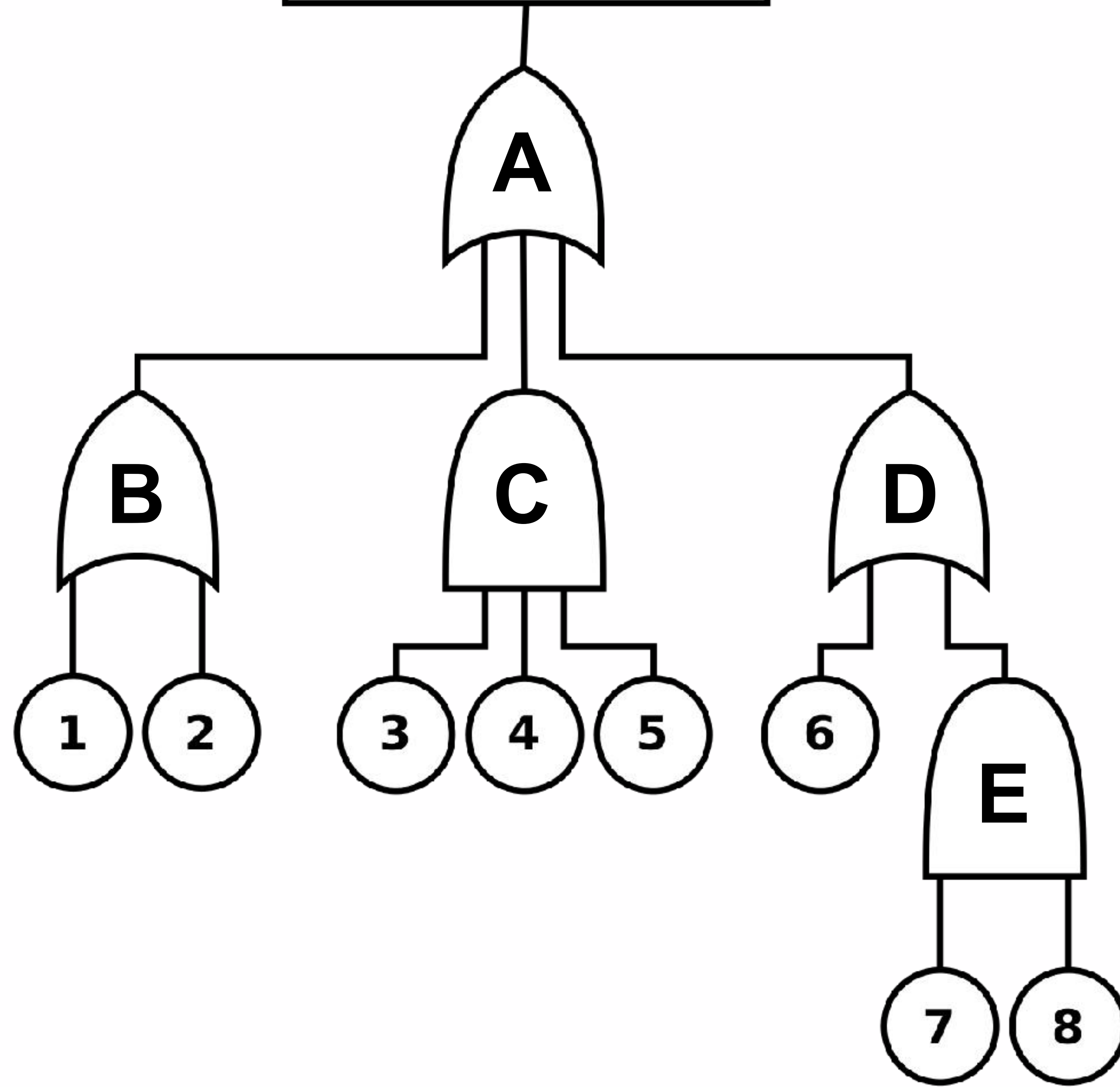
# Subsystem A



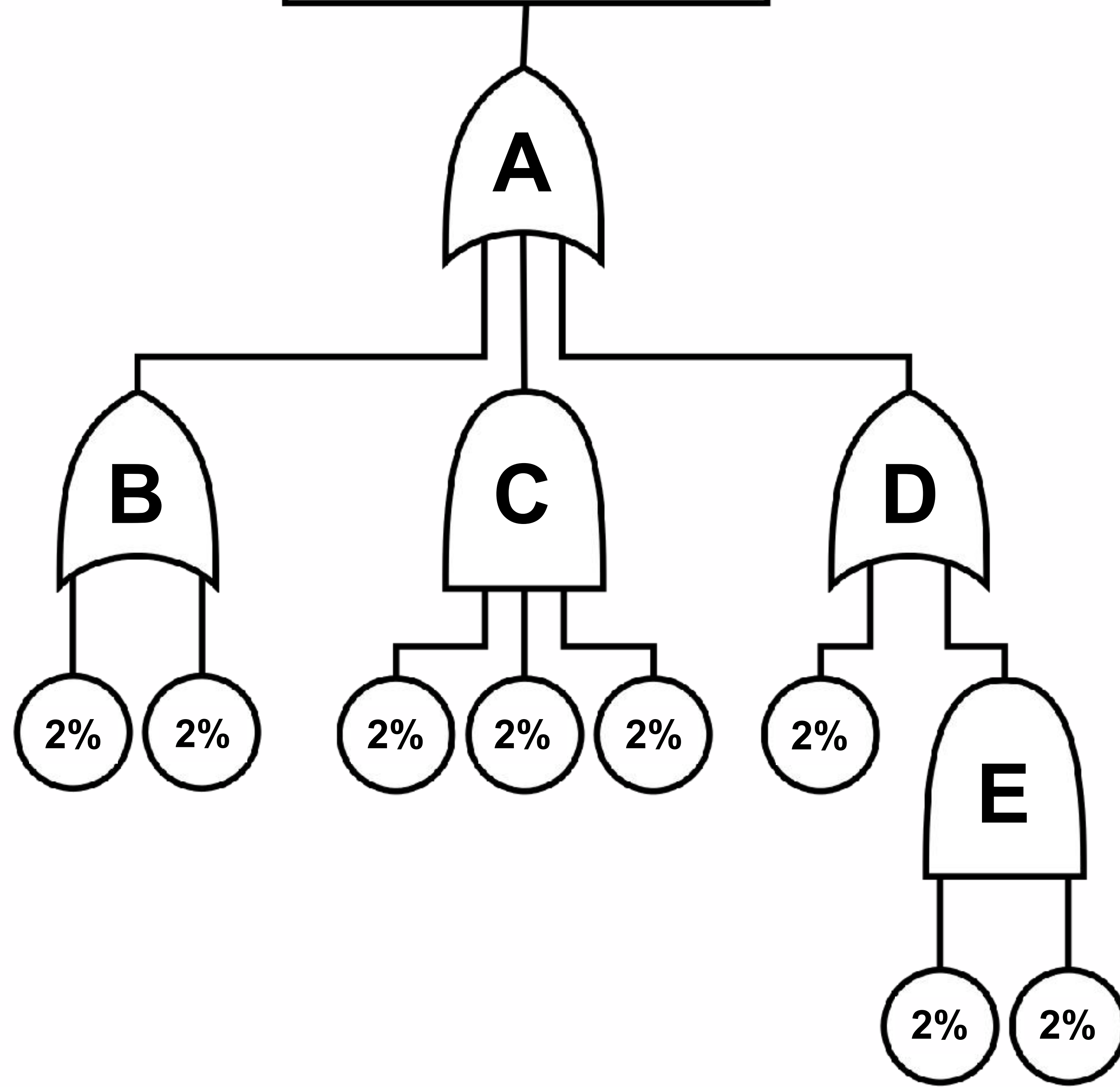
# Subsystem A



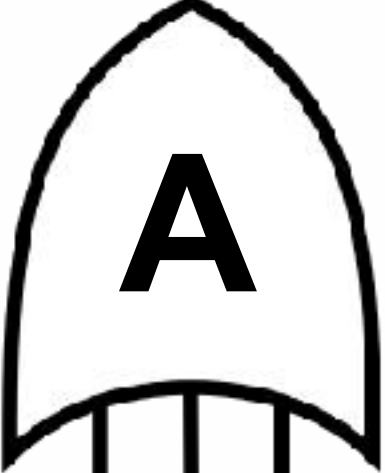
**Subsystem A**



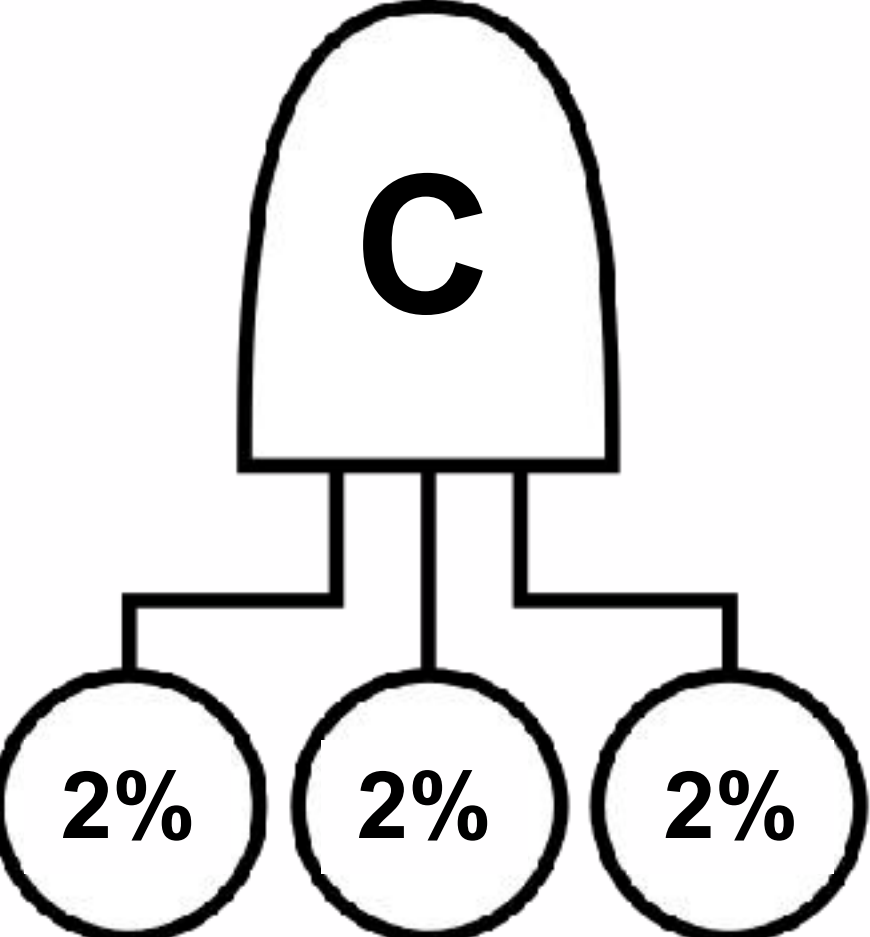
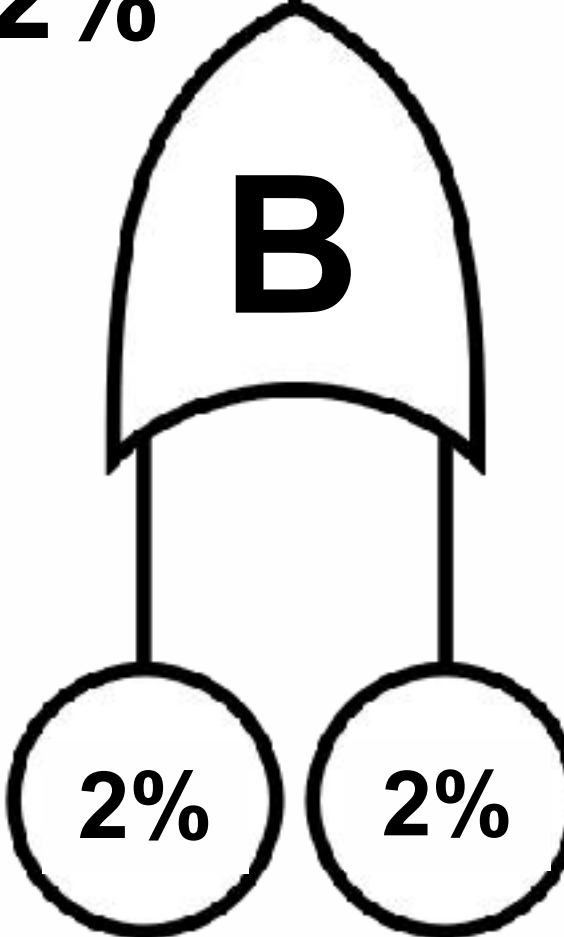
# Subsystem A



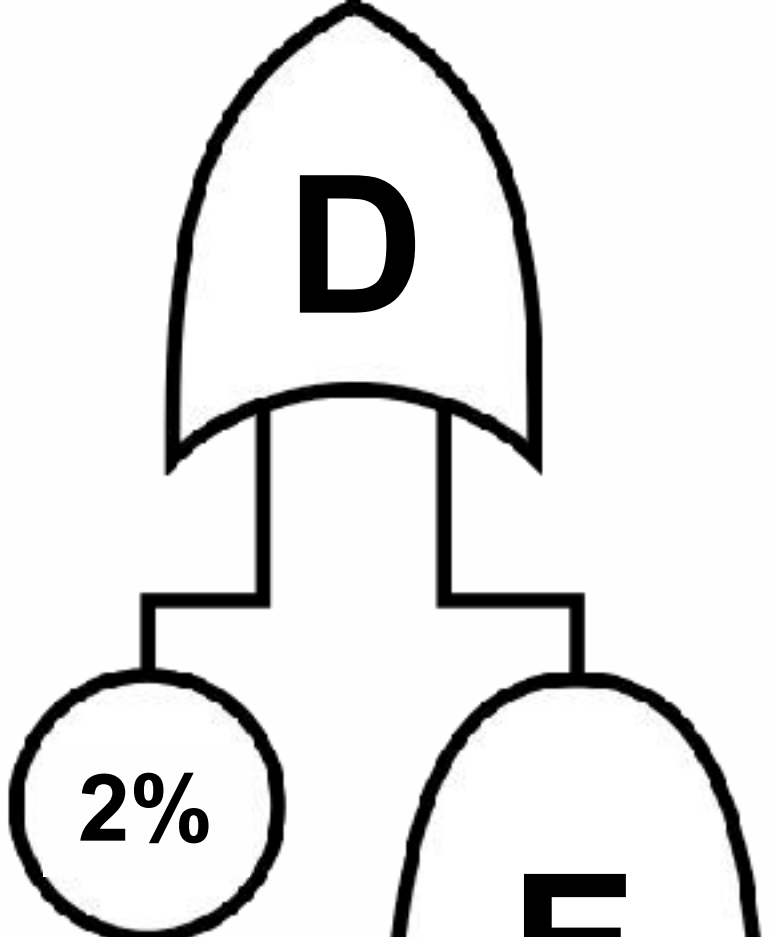
**Subsystem A**



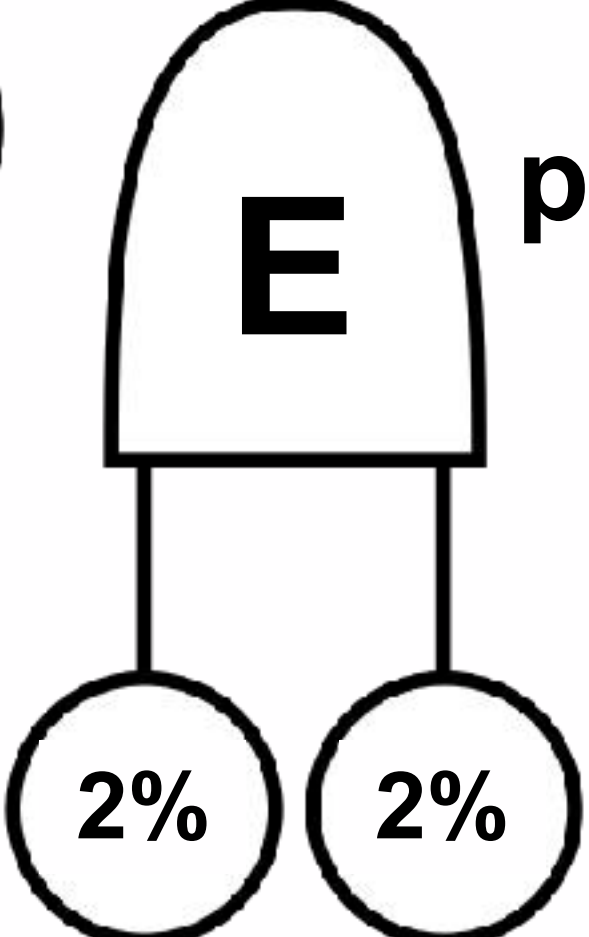
$p(B) = 2\% + 2\%$



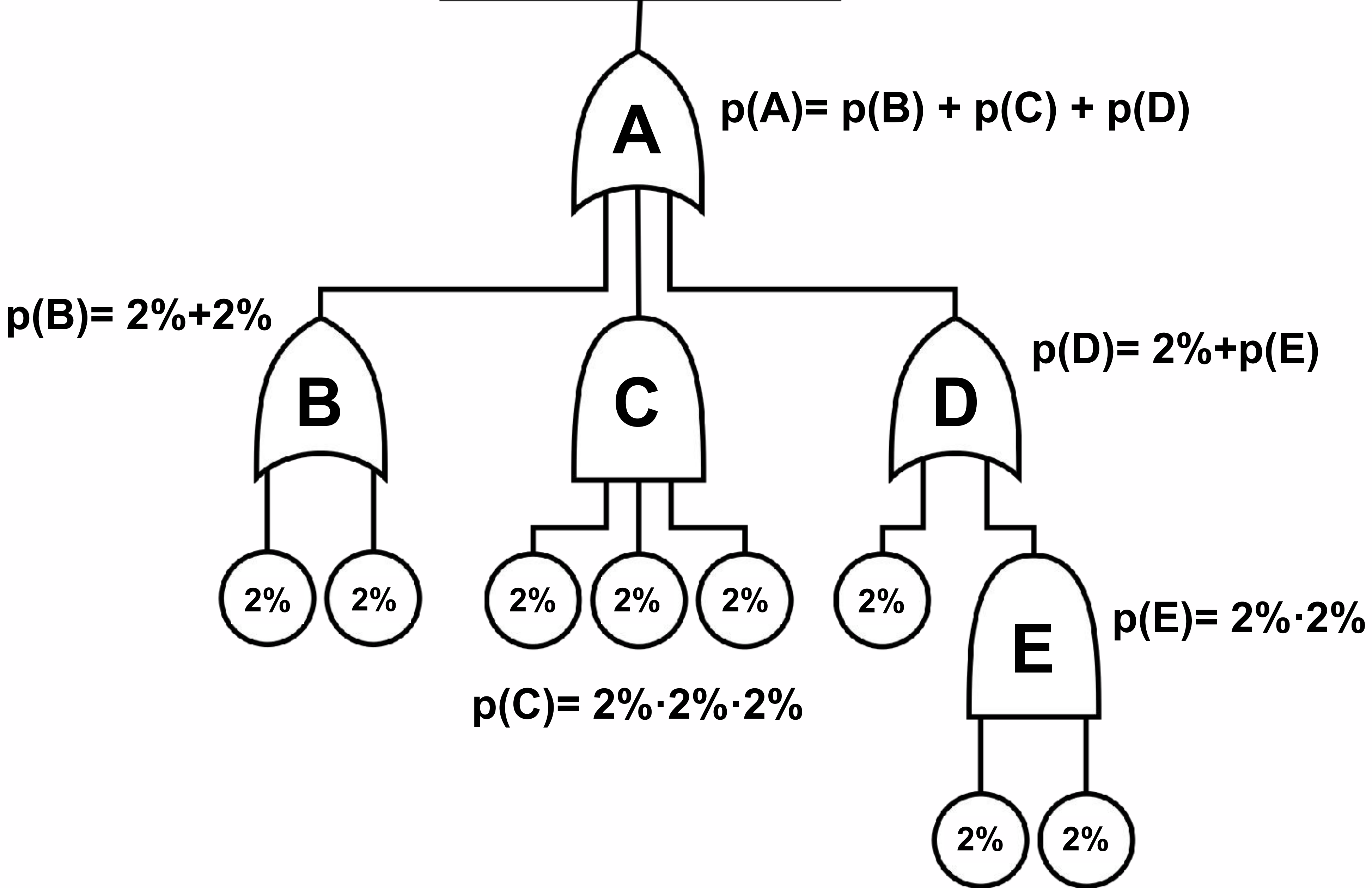
$p(C) = 2\% \cdot 2\% \cdot 2\%$



$p(E) = 2\% \cdot 2\%$

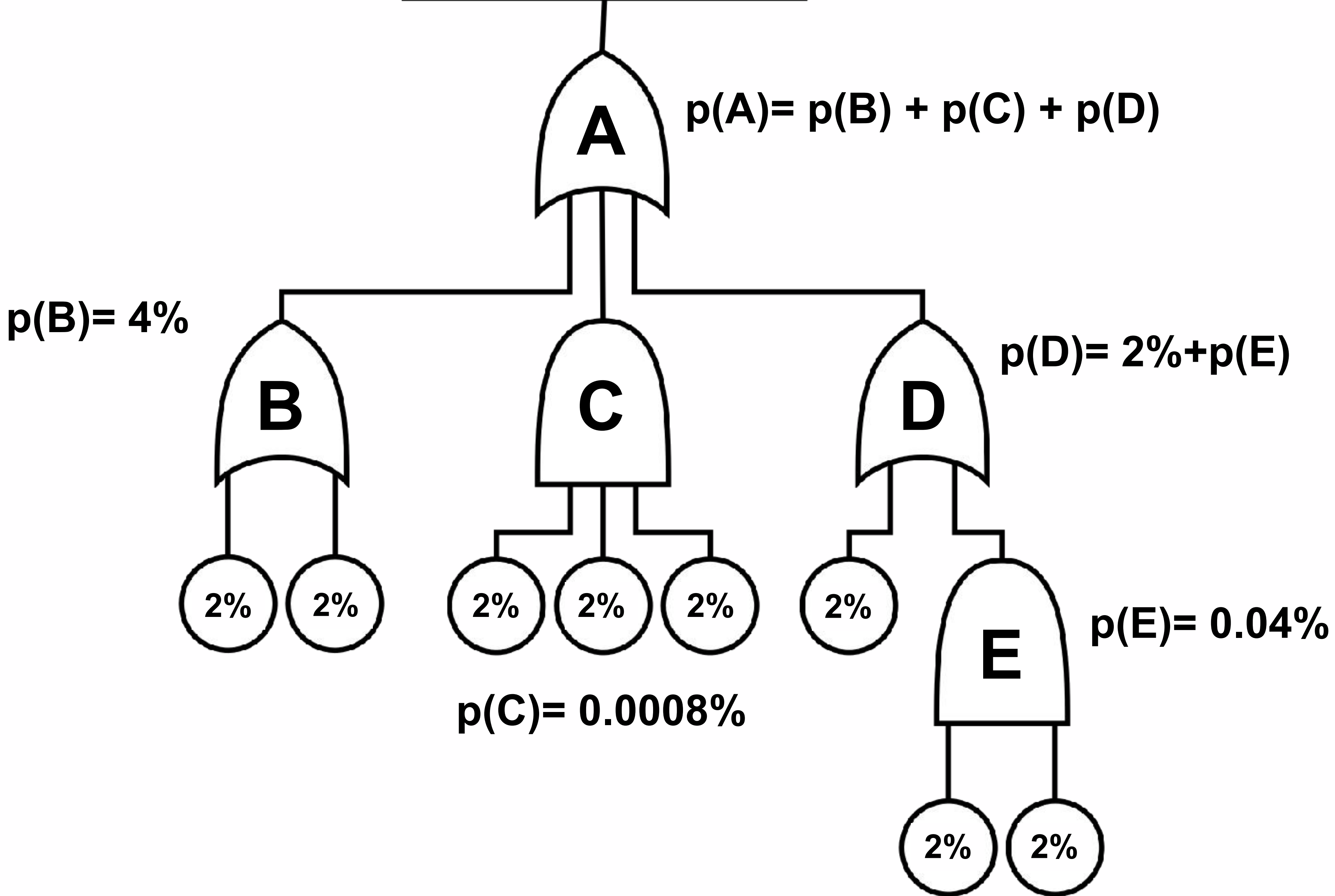


**Subsystem A**

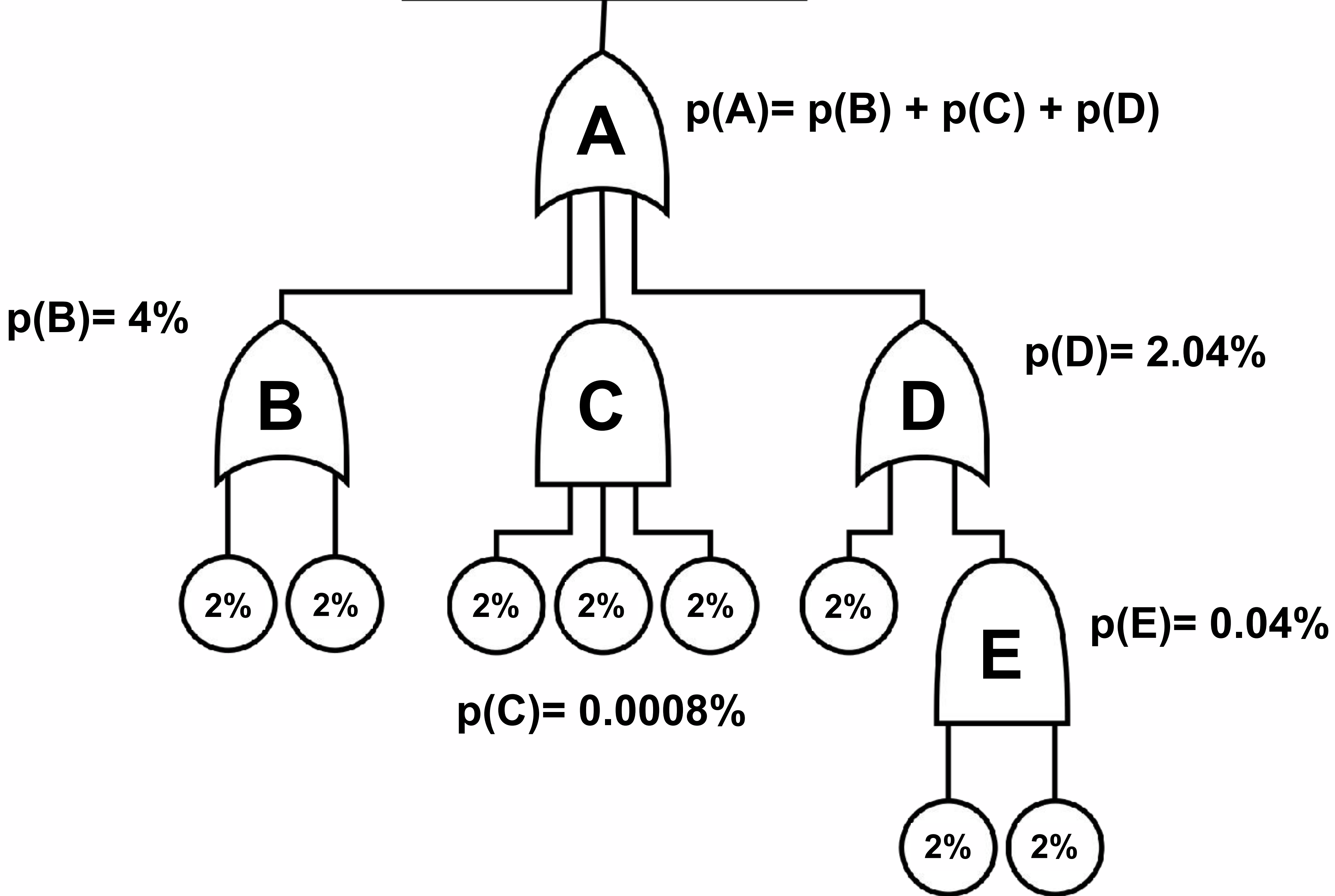


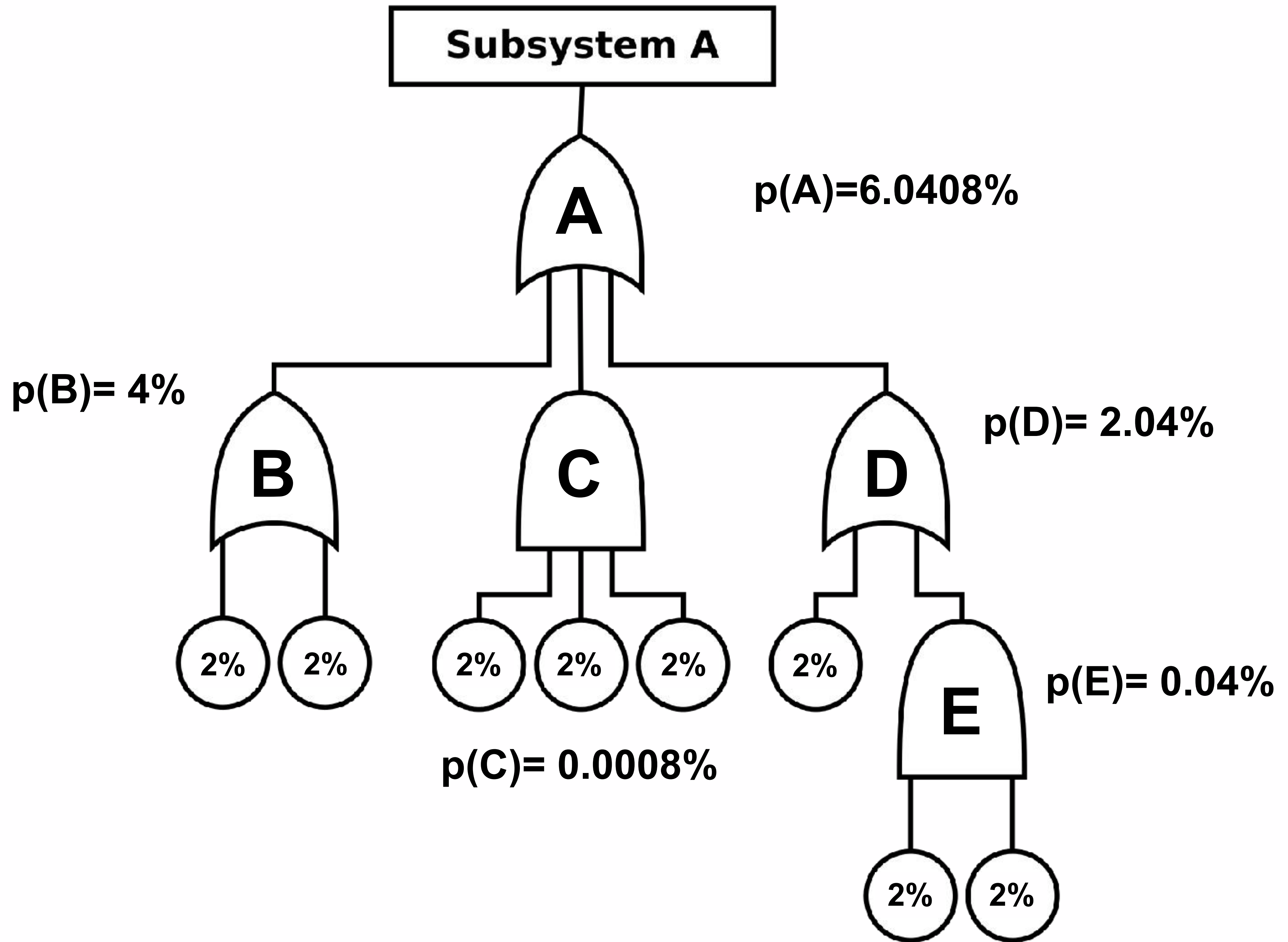


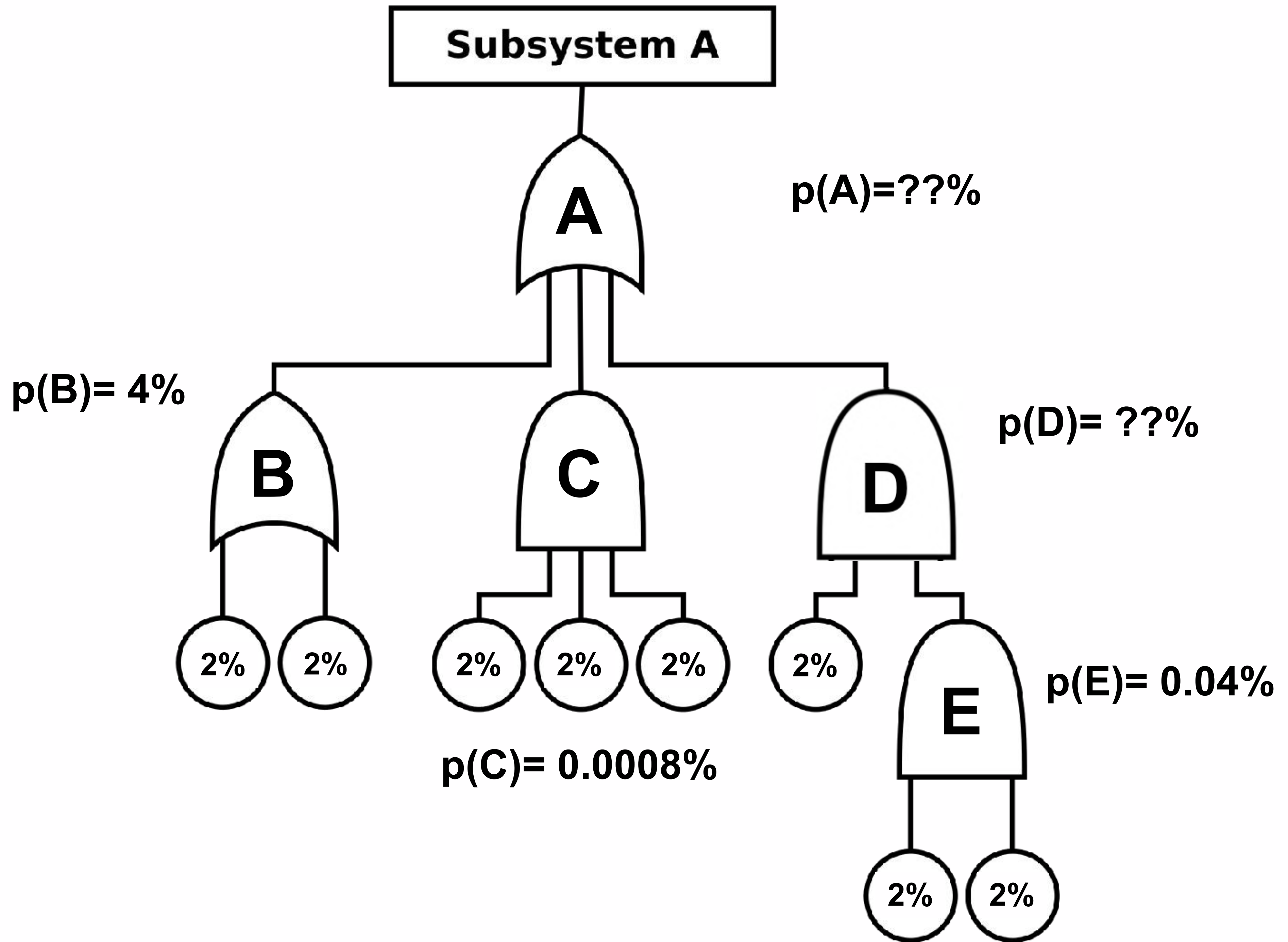
**Subsystem A**

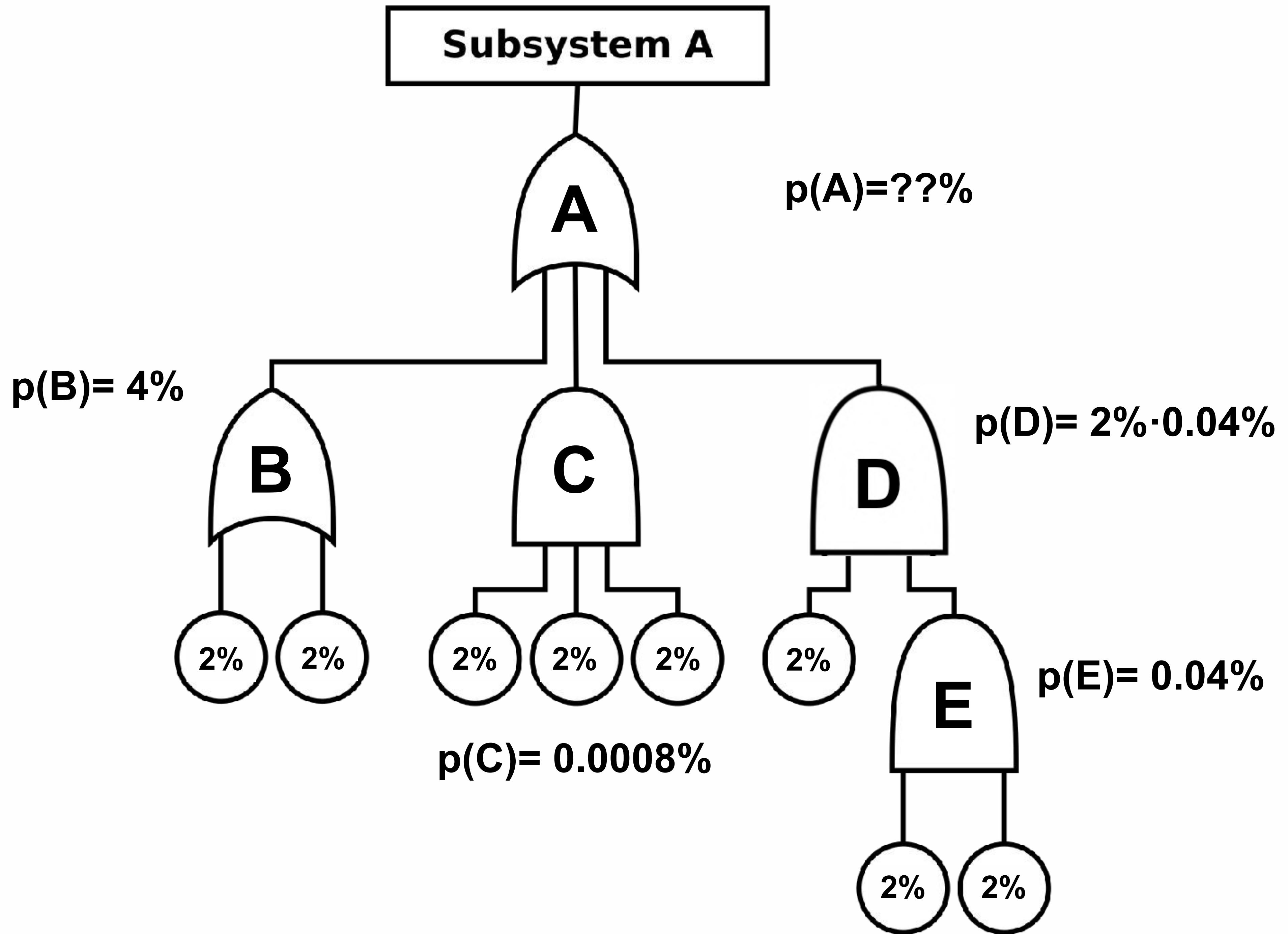


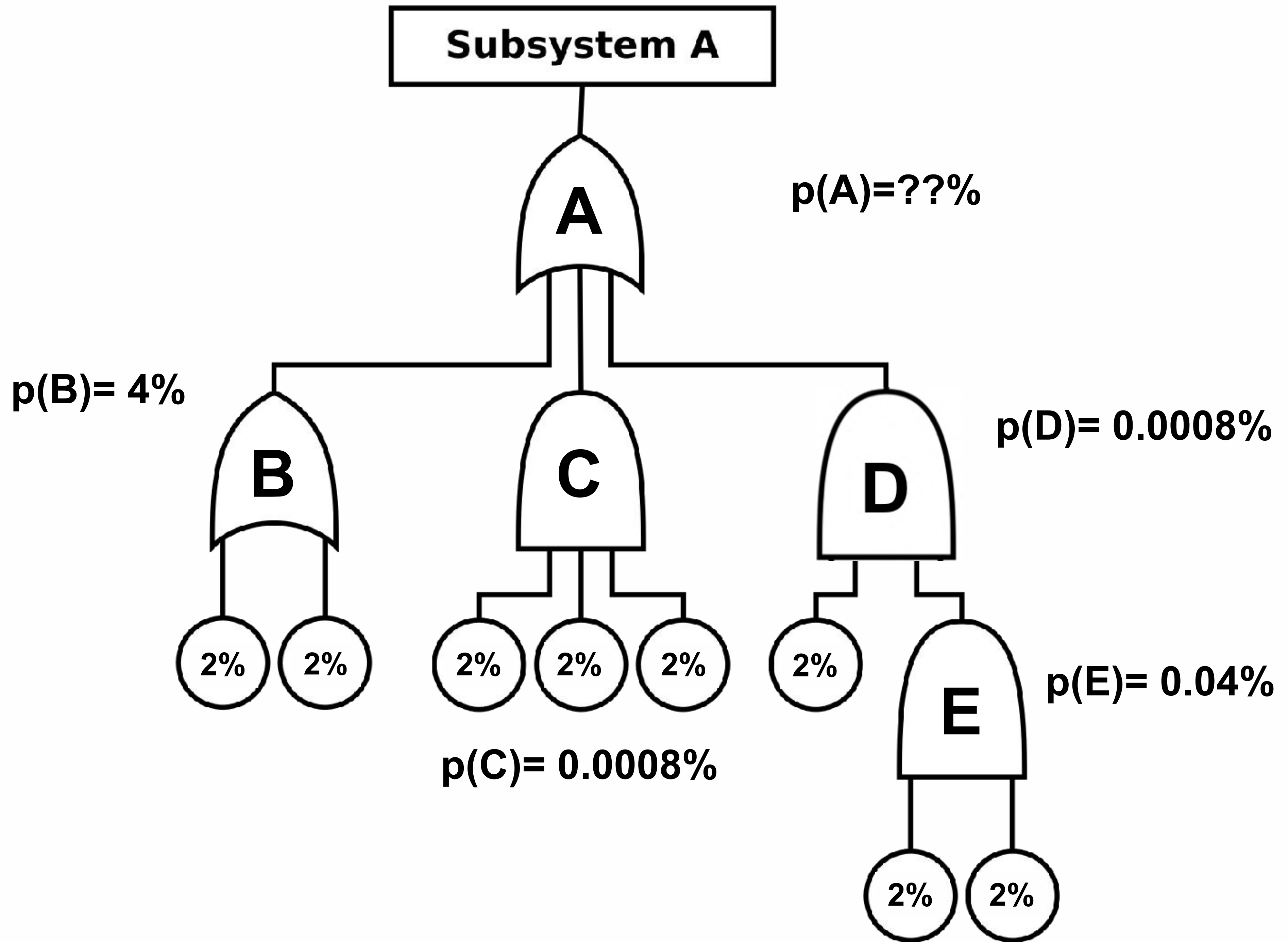
**Subsystem A**

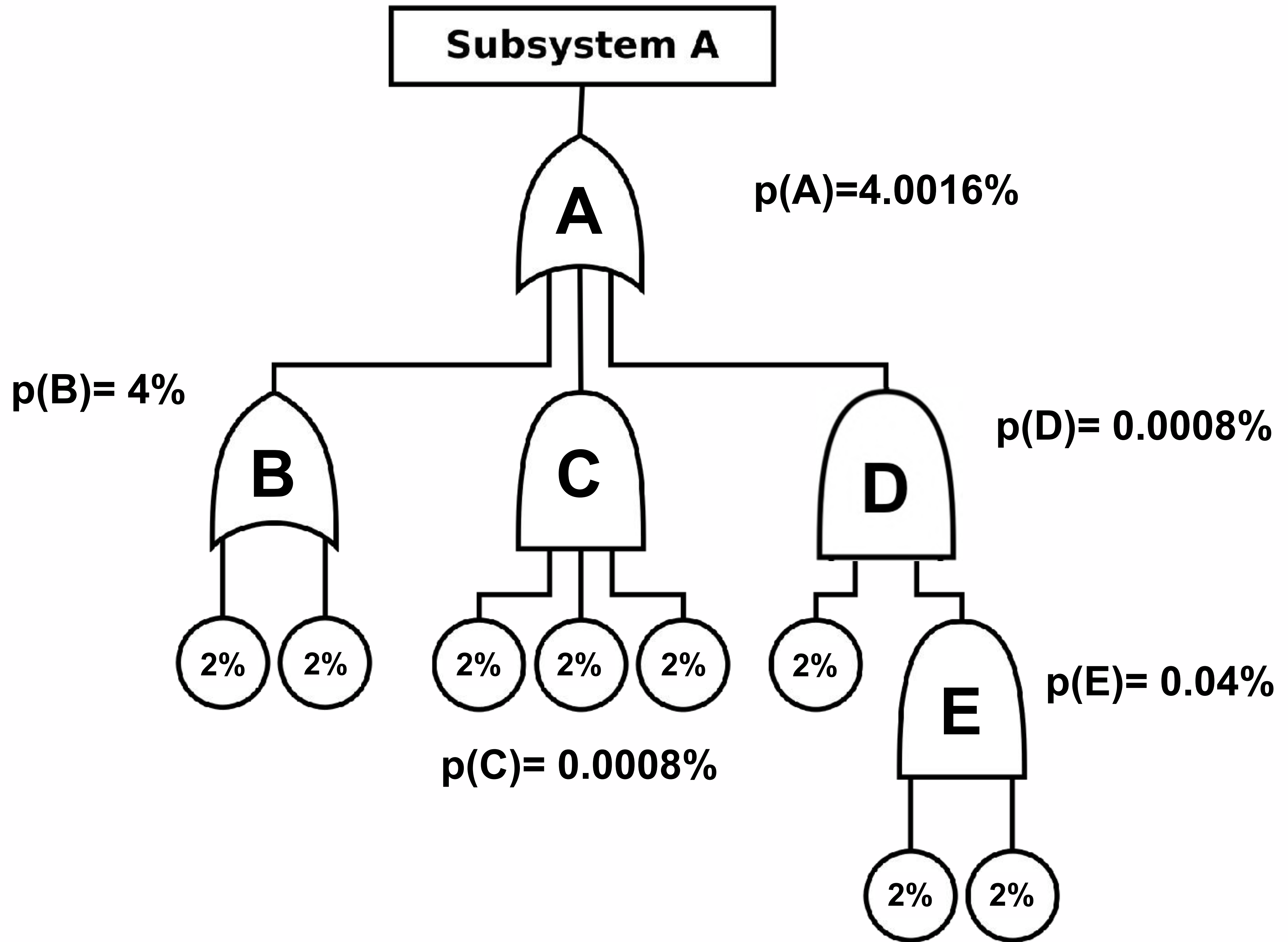


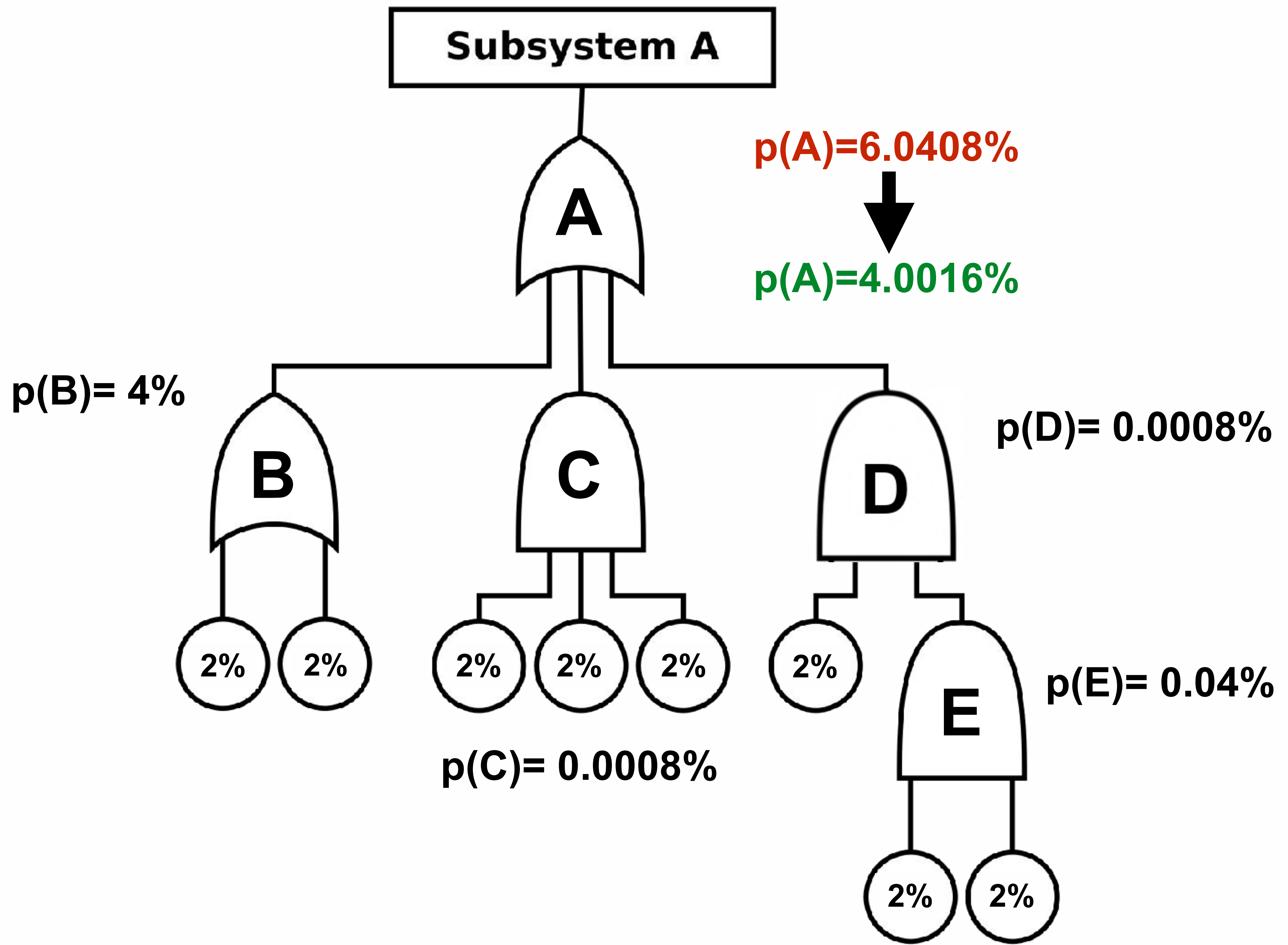














An aerial photograph of a nuclear power plant. Four large, white, hyperboloid cooling towers are prominent, two on the left and two on the right. The plant's complex of buildings and piping is visible in the center. A river flows through the foreground, reflecting the sky. The background shows a rural landscape with fields and distant hills under a clear sky. The text "Learning from Failure" is overlaid in the center in a large, white, sans-serif font.

# Learning from Failure



A photograph of a large, rusted industrial chemical plant. The scene is dominated by several tall, cylindrical tanks and a complex network of pipes and scaffolding. The tanks are heavily corroded, with large areas of rust and peeling paint. A person in a patterned shirt stands in the lower center of the frame, looking up at the machinery, providing a sense of scale. The overall atmosphere is one of decay and abandonment. The text "Center for Chemical Process Safety" is overlaid in white, bold, sans-serif font in the center of the image.

# Center for Chemical Process Safety

A photograph of a destroyed industrial facility. In the foreground, there is a large, chaotic pile of twisted metal, pipes, and debris. In the background, several large, cylindrical industrial tanks are visible, some of which appear to be damaged or partially collapsed. A yellow Caterpillar excavator is partially visible on the right side of the image. Several workers wearing hard hats and safety gear are standing near the debris. The sky is clear and blue. The overall scene suggests a major industrial accident or explosion.

# U.S. Chemical Safety and Hazard Investigation Board



CSB

# Steam Boilers



**Thank you.**