

Security Implications of Malicious G-Codes in 3D Printing

Jost Rossel Vladislav Mladenov
Nico Wördenweber Juraj Somorovsky

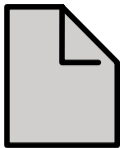
USENIX '25, August 13–15, 2025



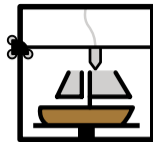
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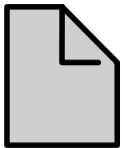




3D Model File



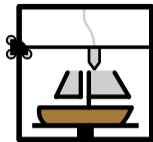
3D Printer



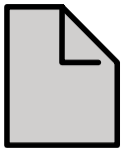
3D Model File



Slicer



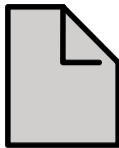
3D Printer



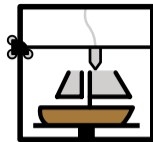
3D Model File



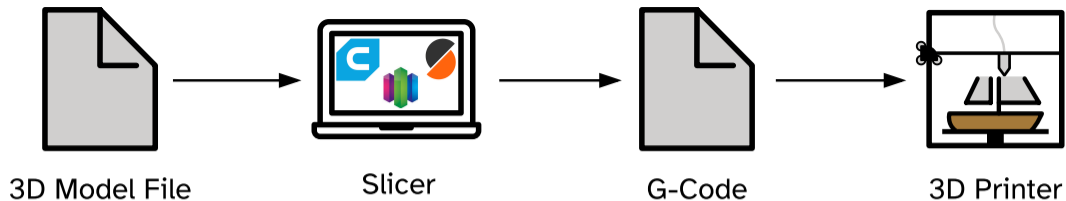
Slicer



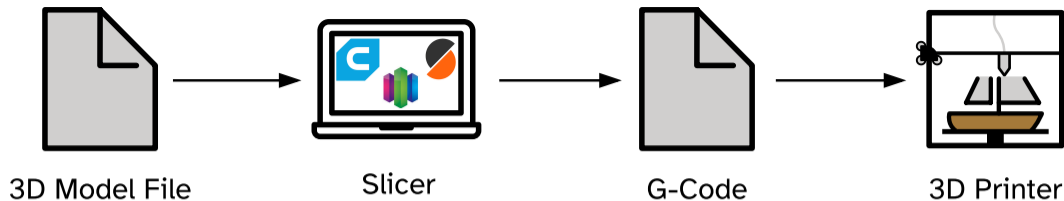
G-Code



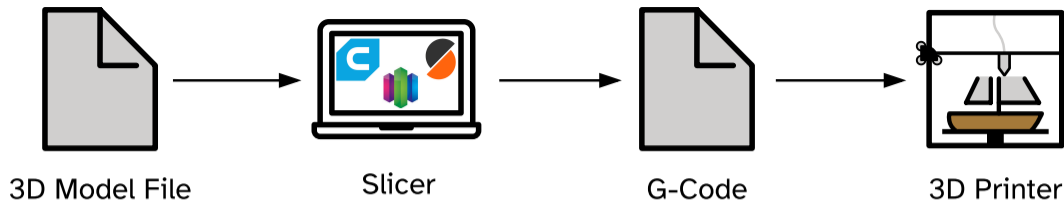
3D Printer



What are G-Codes?

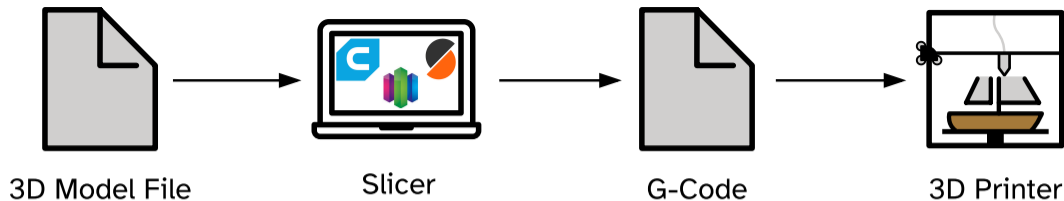


What are G-Codes? → text-based control language



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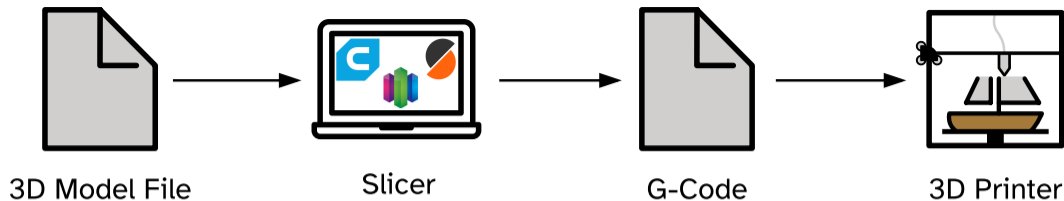
G1 Move print head



What are G-Codes? → text-based control language

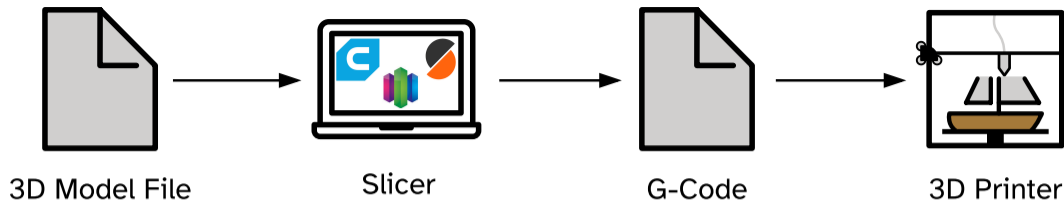
G1 Move print head

M104 Set extruder temperature



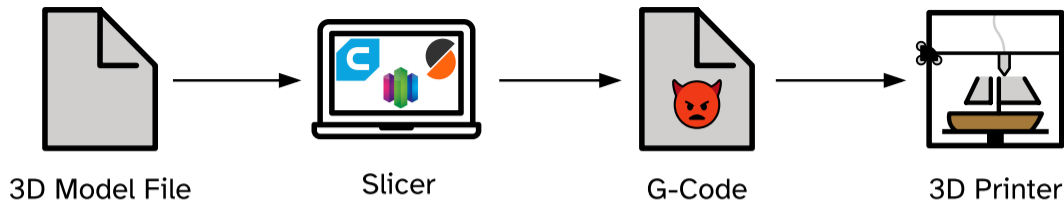
What are G-Codes? → text-based control language

G1	Move print head
M104	Set extruder temperature
M500	Save current configuration



What are G-Codes? → text-based control language

G1	Move print head
M104	Set extruder temperature
M500	Save current configuration
M997	Update firmware



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...assuming an
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What can an attacker with limited capabilities achieve?

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What can an attacker with limited capabilities achieve?

→ Gather and analyze existing G-Codes.

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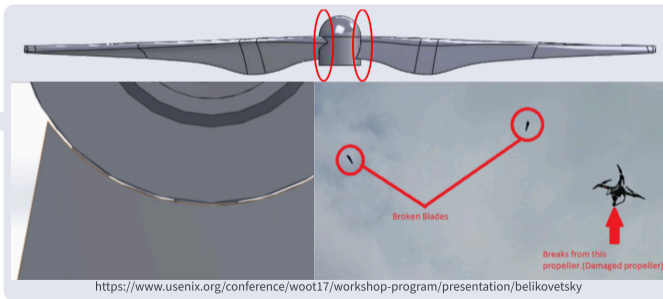
- Gather and analyze existing G-Codes.
- Extract attacks in the categories
 - Information Disclosure
 - Denial of Service, and
 - Model Manipulation.

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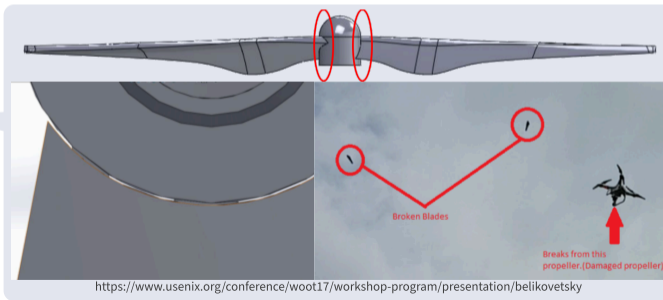


...assuming an
“almighty” attacker

Known: “G-Codes can be dangerous”

What can an attacker with limited capabilities achieve?

- Gather and analyze existing G-Codes.
- Extract attacks in the categories
 - Information Disclosure
 - Denial of Service, and
 - Model Manipulation.
- Evaluate attacks on printers.



<https://www.usenix.org/conference/woot17/workshop-program/presentation/belikovetsky>

Results

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- Details:

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Attacker Capabilities

