AI and Fire Safety Engineering: Opportunities and challenges

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Outline

- What is Artificial Intelligence?
- Theory-driven vs data-driven approaches
- AI in FSE research, practice and education
- Examples of AI and FSE tools

Will we all lose our FSE jobs?

What is Artificial Intelligence?

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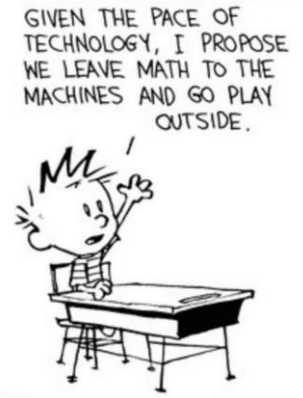
- AI is the theory and development of computer systems able to perform tasks requiring **human intelligence**
- **Machine learning (ML)** is a subfield of AI that uses algorithms trained on data to produce models that can perform complex tasks
- **Generative AI** is a type of AI system capable of generating text, images, or other media in response to prompts
- Recently, **chatbots** like ChatGPT, are built on large language models, that are developed to answer to **prompts** enabling users to refine and steer a conversation towards a desired length, format, style, level of detail, and language used.



Calvin and Hobbes

What is Artificial Intelligence?

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There are several possible uses of AI, machine learning and Generative AI (e.g., chatbots) in FSE research, practice and education, including:

- Create images and sounds
- Find out information
- Create code
- Improve text based on prompts
- Write text based on prompts

… and many more

But, what is the main conceptual difference between an AI tool and an "old school" simulation?

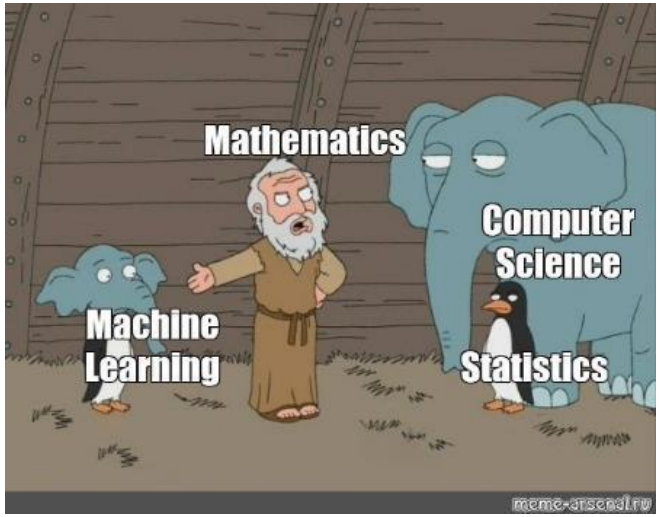
Theory-driven vs data-driven research

Theory-driven
Galilean scientific method
Formulate/use a theory/hypothesis → Test theory/hypothesis with data, e.g., experiments

Pros → Knowing fundamentals allow generalizability of findings, isolating the effects of specific variables
Cons → Harder to make sense of data, can take time to iteratively build knowledge ☹

Data-driven
Collect data → Try to give a sense to the data by identifying patterns (e.g., machine learning)

Pros → No need to explain why → Interpret large data and use them for fire safety purposes
Cons → We do not know why → Hard to extrapolate findings to other contexts and/or clearly understand when/where findings apply



AI in FSE research, practice and education

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Up to recent times, most of Fire Safety Engineering relied on **theory-driven tools**, e.g., fire simulations based on physics (e.g., CFD, zone models, etc.) evacuation simulations on human behaviour theories (e.g., agent-based), etc.

- Is a paradigm shift needed?
- Will AI change our current research, practice and education workflow?
- What AI-based tools do we already have now (or will be soon available?)

AI in FSE research, practice and education

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Examples of AI-based tools in FSE

- Quickly screening codes for info (check out Mike Kinsey's talk at the Fire Science Show!)
- Automated prescriptive code checker
- Fire detection using ML (check Martinsson et al, 2022 looking at acoustics!)
- Help writing fire simulation code
- Smart fire-fighting based on large data
- New generation of (quick) data-driven models
- Generative design

and many more…

https://www.firescienceshow.com/095-an-ai-supported-fire-safety-engineer-with-michael-kinsey/

Examples of AI and FSE tools

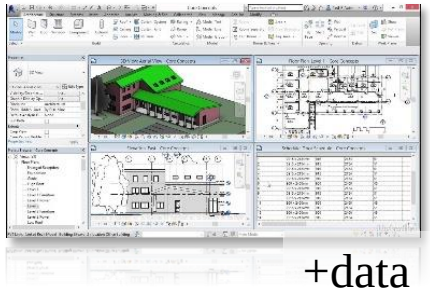
Until today:

One-way data sharing

From Geometry →
To fire or evacuation simulator

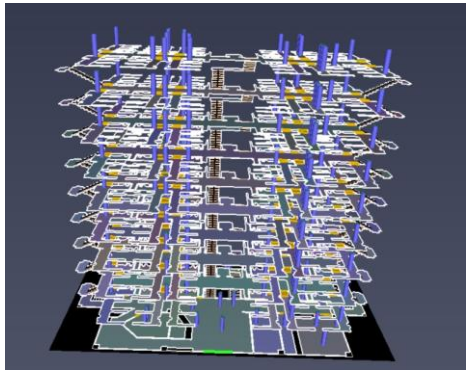
CAD

BIM

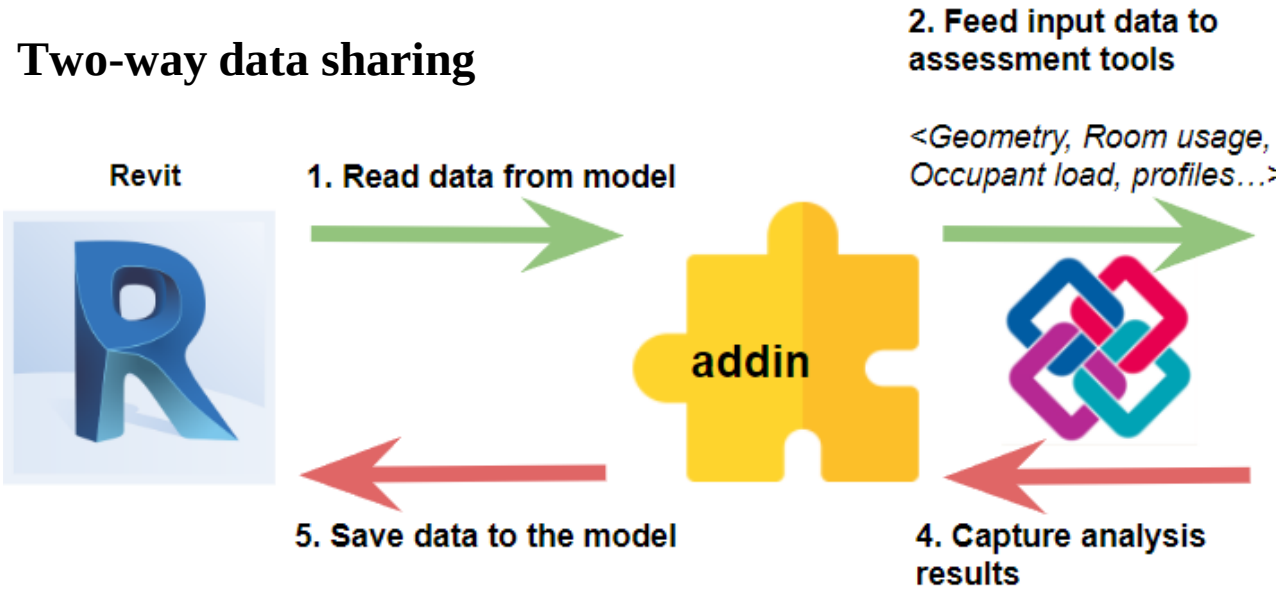


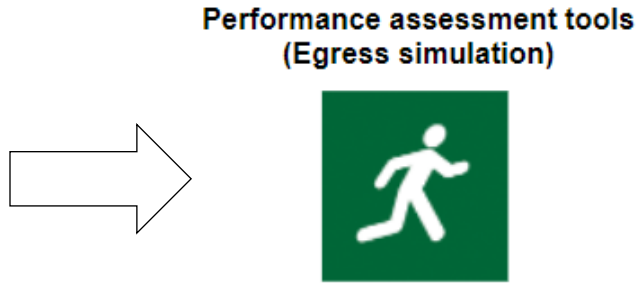
+data

FBX, other



Examples of AI and FSE tools





https://github.com/YakNazim/Evac4Bim

Export into IFC
Including proposed FSE egress specifications

IFC file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The integration of building information modelling and fire evacuation models

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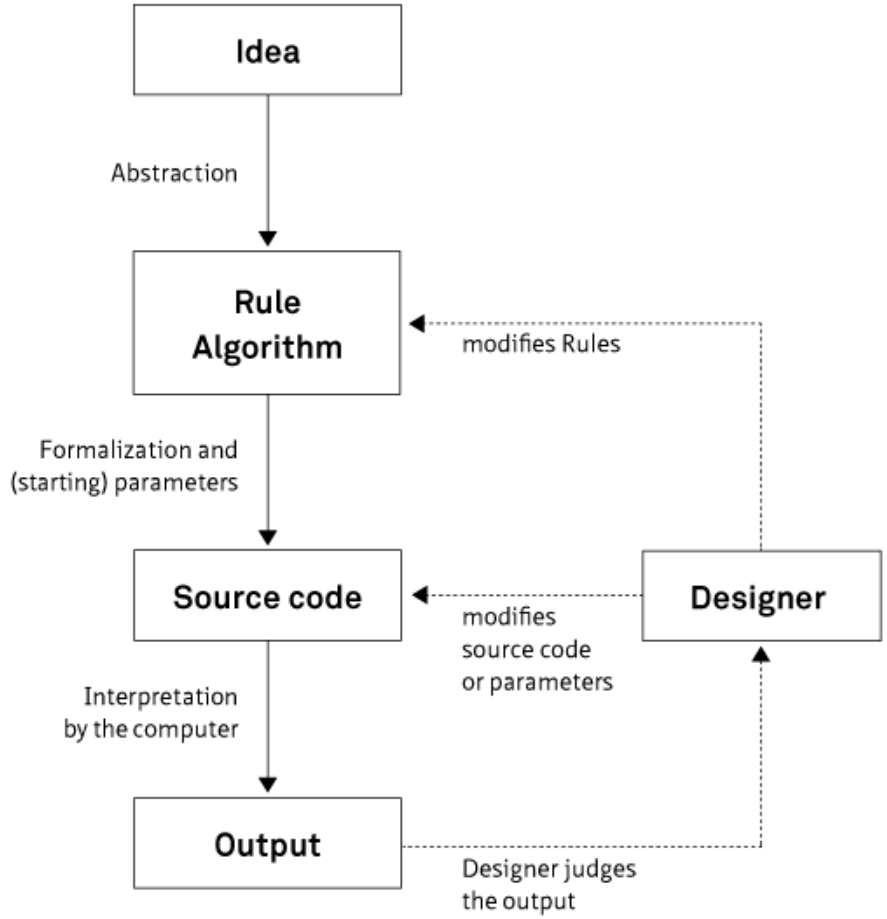
… and many more!!!

Examples of AI and FSE tools

Why **automation** of data sharing (e.g., via BIM) is a big deal in FSE simulations?

It opens up for **generative design** applications!

You can set up **rules of acceptance** for your fire safety design and let the machine iteratively check if your current design meets the set criteria!

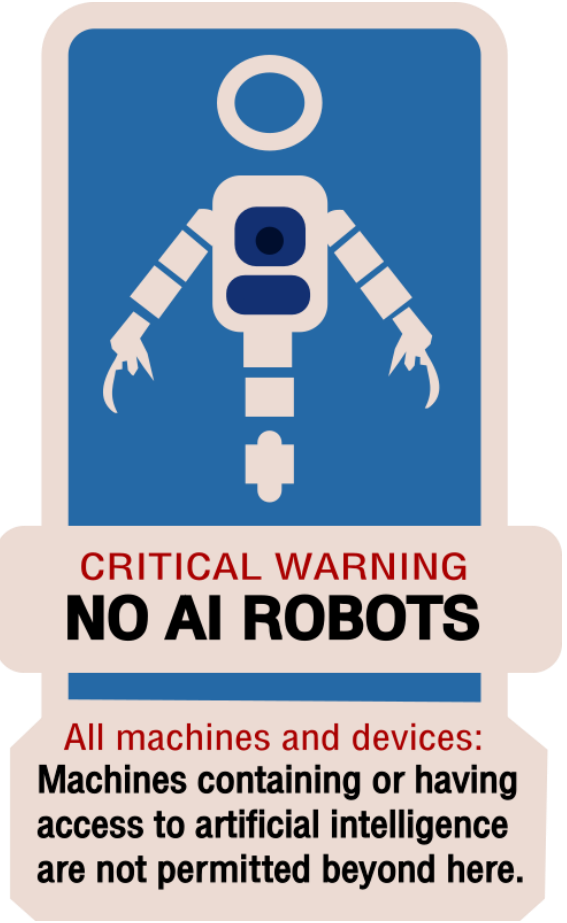


Will we all lose our FSE job?

Fairly soon, **prescriptive fire safety design** may require less people → many steps can be automated by AI

Ethical issues remain, will **you** live in a building fully designed by a machine without human oversight?

Why supervision of humans today is still essential?



openclipart.org

Will we all lose our FSE job?

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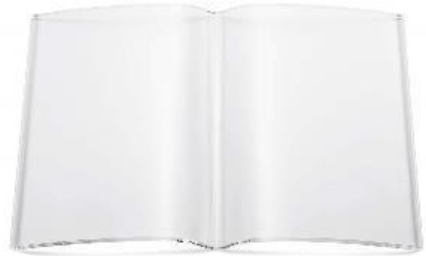
Hallucinations!

My two bad experiences so far:

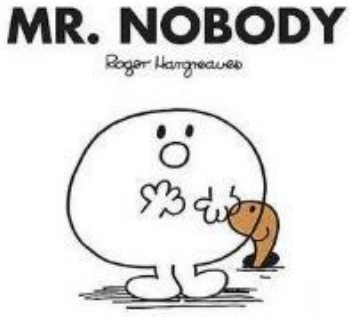
The inexistent book request

Good morning Enrico, … I am student in… … while reviewing existing literature I found online a book called "Fire Safety in Railway Tunnels" written by Colin A. Bailey and Enrico Ronchi., could you please send me a .pdf?



The made-up references in a grant application

The listed references do not exist. For instance, the Swedish names listed in the literature review of this project proposal are made up.



Will we all lose our FSE job?

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The machine learning joke

a human and a machine are in a bar and start chatting…

Human: Hey AI! What's your biggest strength?
Machine: I am a fast learner
Human: What is 6 * 6 ?
Machine: 4
Human: Not even close! It is 36!
Machine: It is 36.

With ML, you may get the right answer, but the machine will not know why!

Will we all lose our FSE job?

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A final answer?

No, it's unlikely that all fire safety engineers will lose their jobs due to generative AI. While generative AI can automate certain aspects of the design process and enhance efficiency, it is not a replacement for the full range of skills and expertise that fire safety engineers bring to the table.

Will we all lose our FSE job?

At least according to ChatGPT today…

Ah ah ah, this is what I say today, let's talk again in 5 years…

Contacts

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