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Department of Computer Science
University of Oxford
8th April 2023

Probabilistic Machine Learning
Introduction

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Introductions

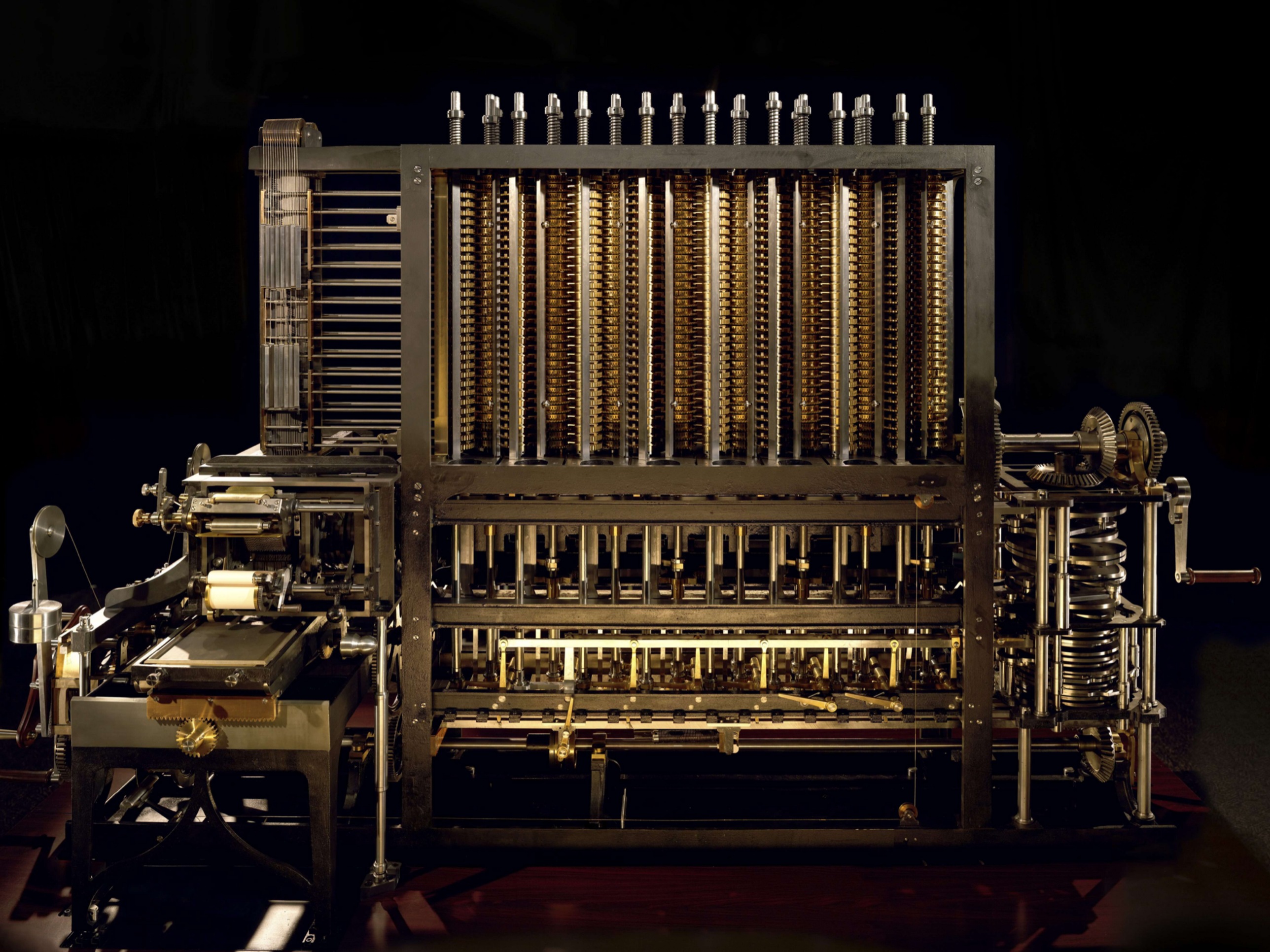
University of Oxford

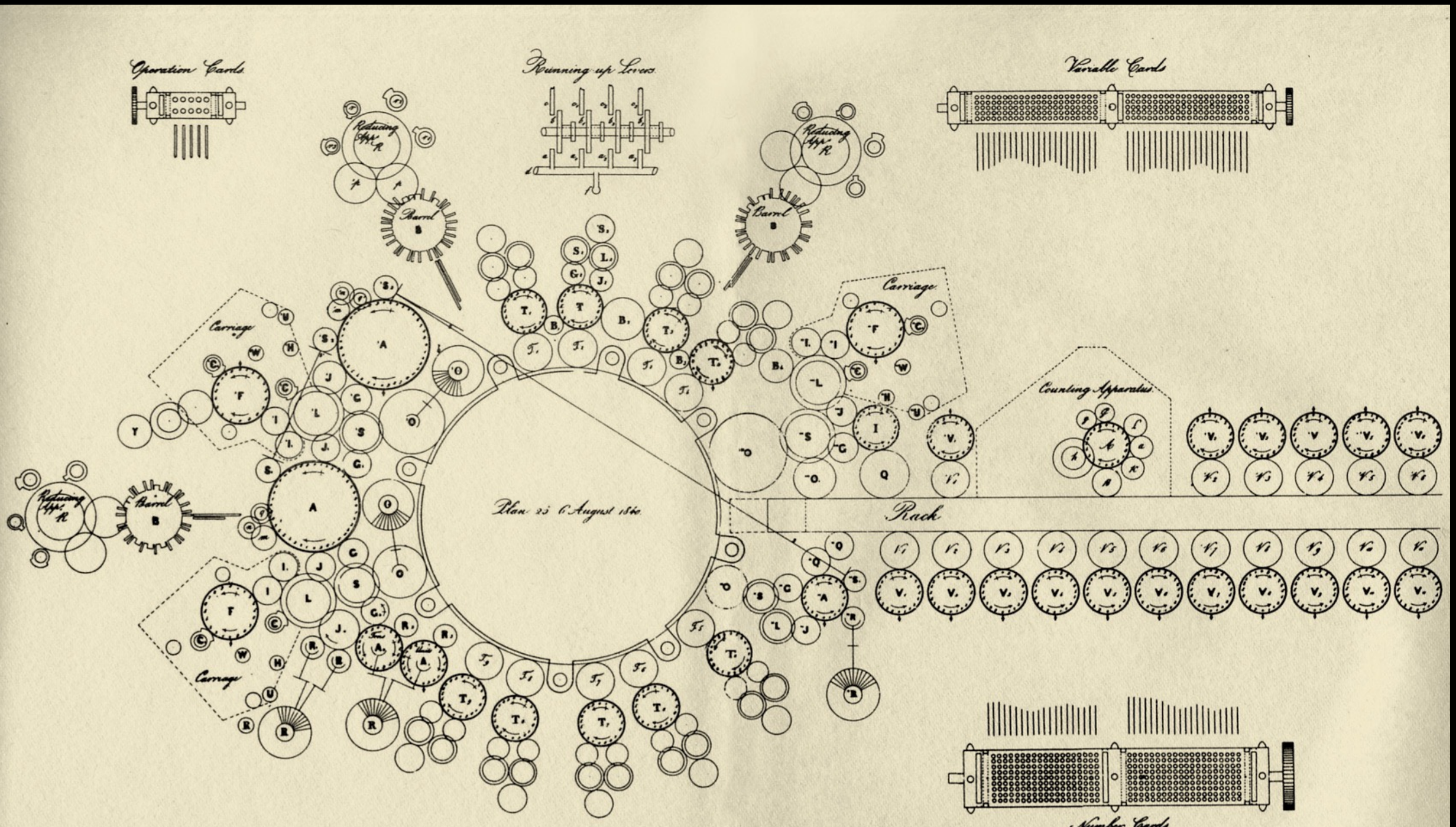

St Anne's College


CAUTION


UNIVERSITY OF
OXFORD
Department of
Computer Science
→ (Entrance on Parks Road)

Computer Architecture





General plan of Mr Babbage's great calculating engine, 1840.

Samuel N Alexander

First Draft of a Report
on the EDVAC

by

John von Neumann

Contract No. W-670-ORD-4926

Between the

United States Army Ordnance Department

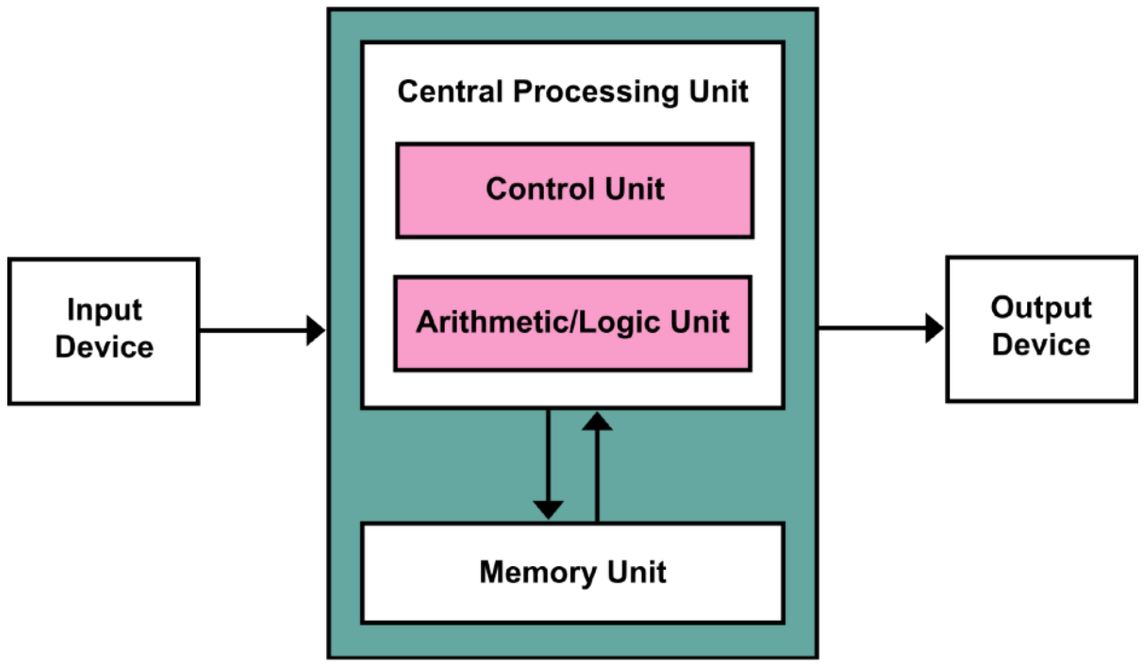
and the

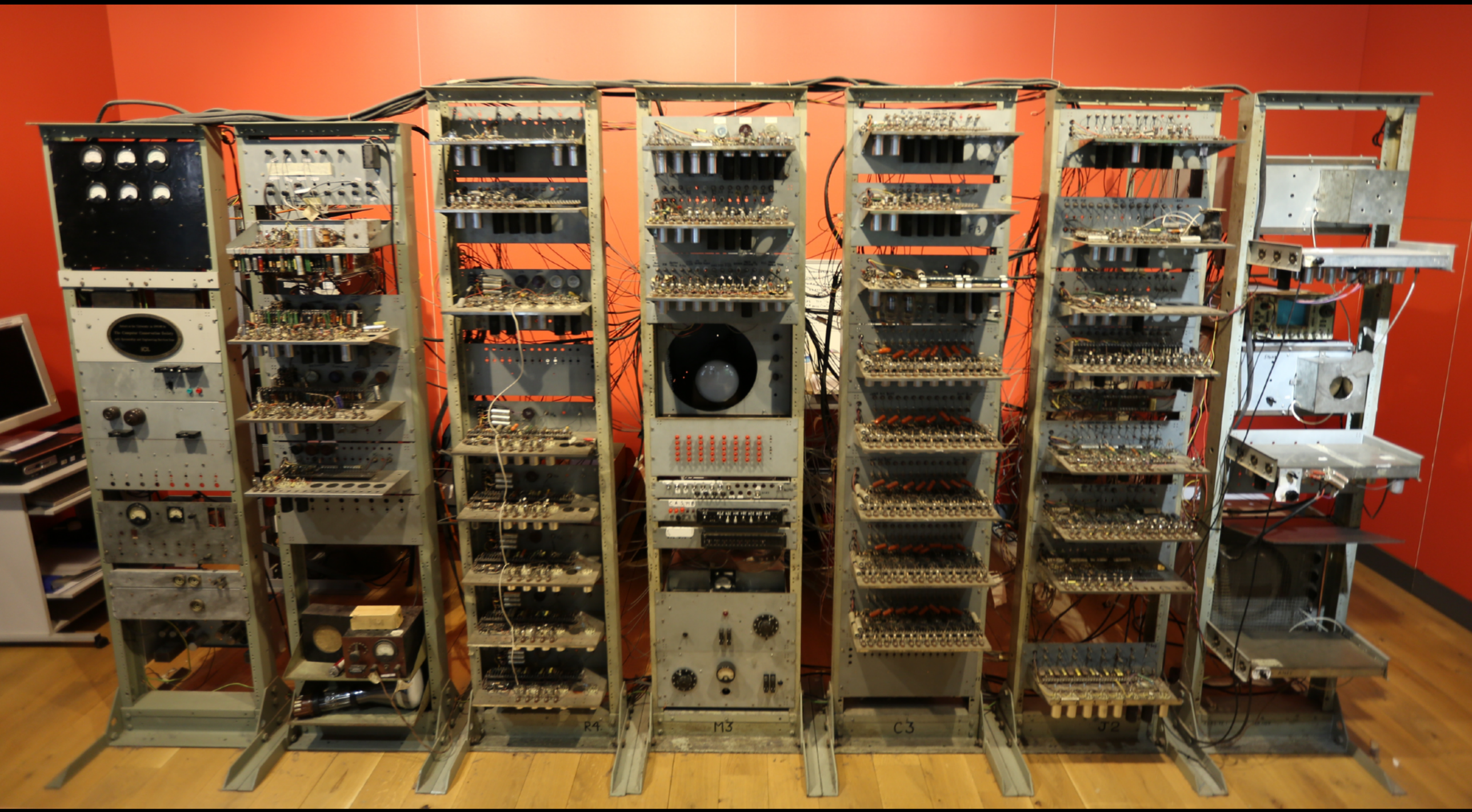
University of Pennsylvania

Moore School of Electrical Engineering
University of Pennsylvania

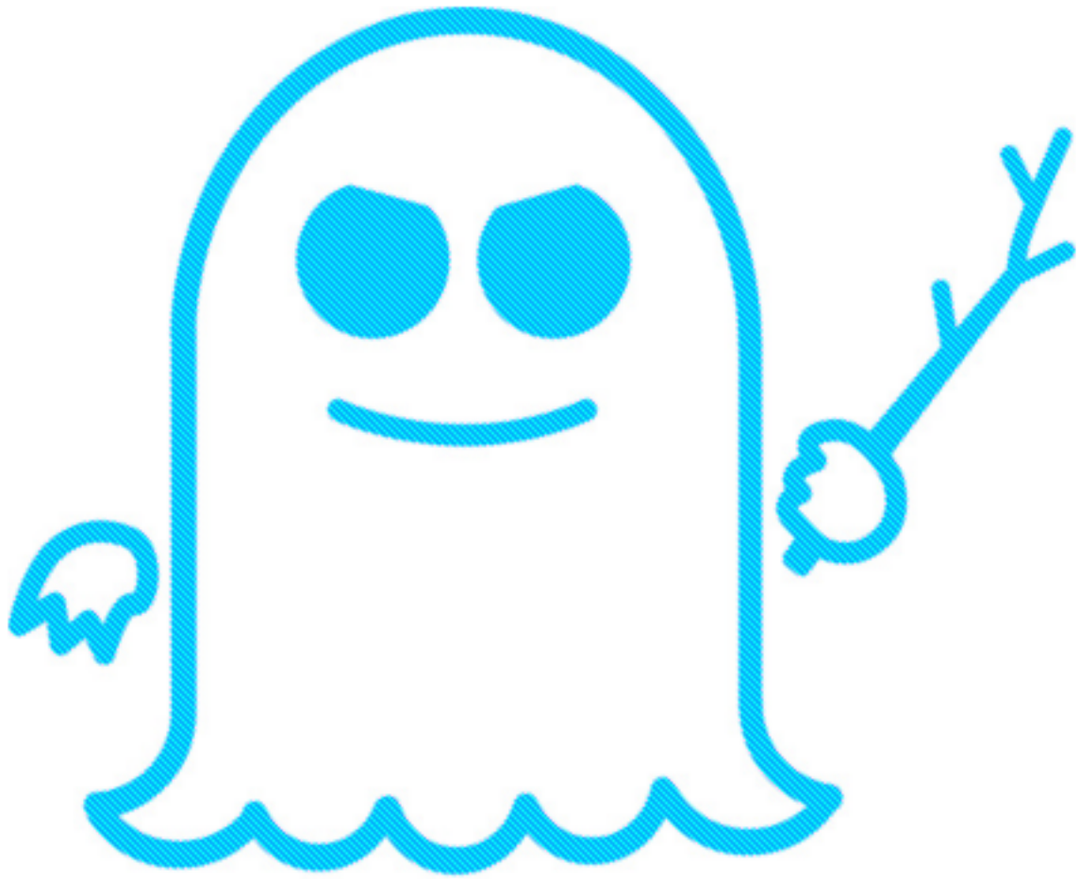
June 30, 1945

National Bureau of Standards
Division 12
Data Processing Systems




R4
M3
C3
J2


intel
CORE i9
X-series
R4



SPECTRE

MELTDOWN

Cyber-Physical Systems

MY Joulo

1. Record

Place the device on top of the thermostat in your home and press the button to start recording. The button will begin to flash green so you know its recording.

2. Upload

After a week, recording will stop and the button will flash red. Plug the device into a computer's USB port. Log on to www.myjoulo.com and follow the steps to upload your data.

3. View

21°

After your data is uploaded, your temperature records will be analysed. The website will then give you personalised advice on how to reduce your heating bill.

4. Discuss

After the trial, why not give us a call to discuss ways of improving your homes efficiency? We use your Joulo data to suggest the right technology and improvements for you.

MyJoulo – Home

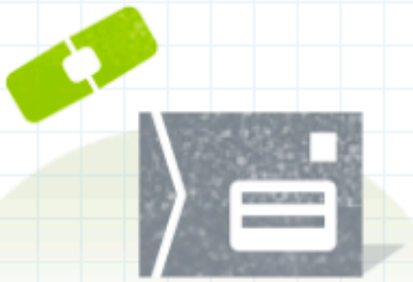
https www.myjoulo.com

Reader

MY Joulo BETA

Order your free logger | Upload your data | Login to view your usage

Personalised energy advice in three simple steps



Order your free logger

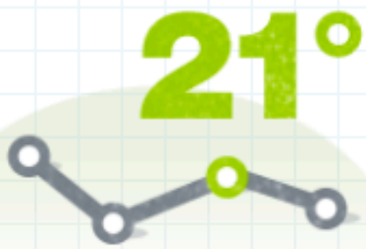
1

Register for an account with us and we'll send you a free Joulo logger.

Record your data

2

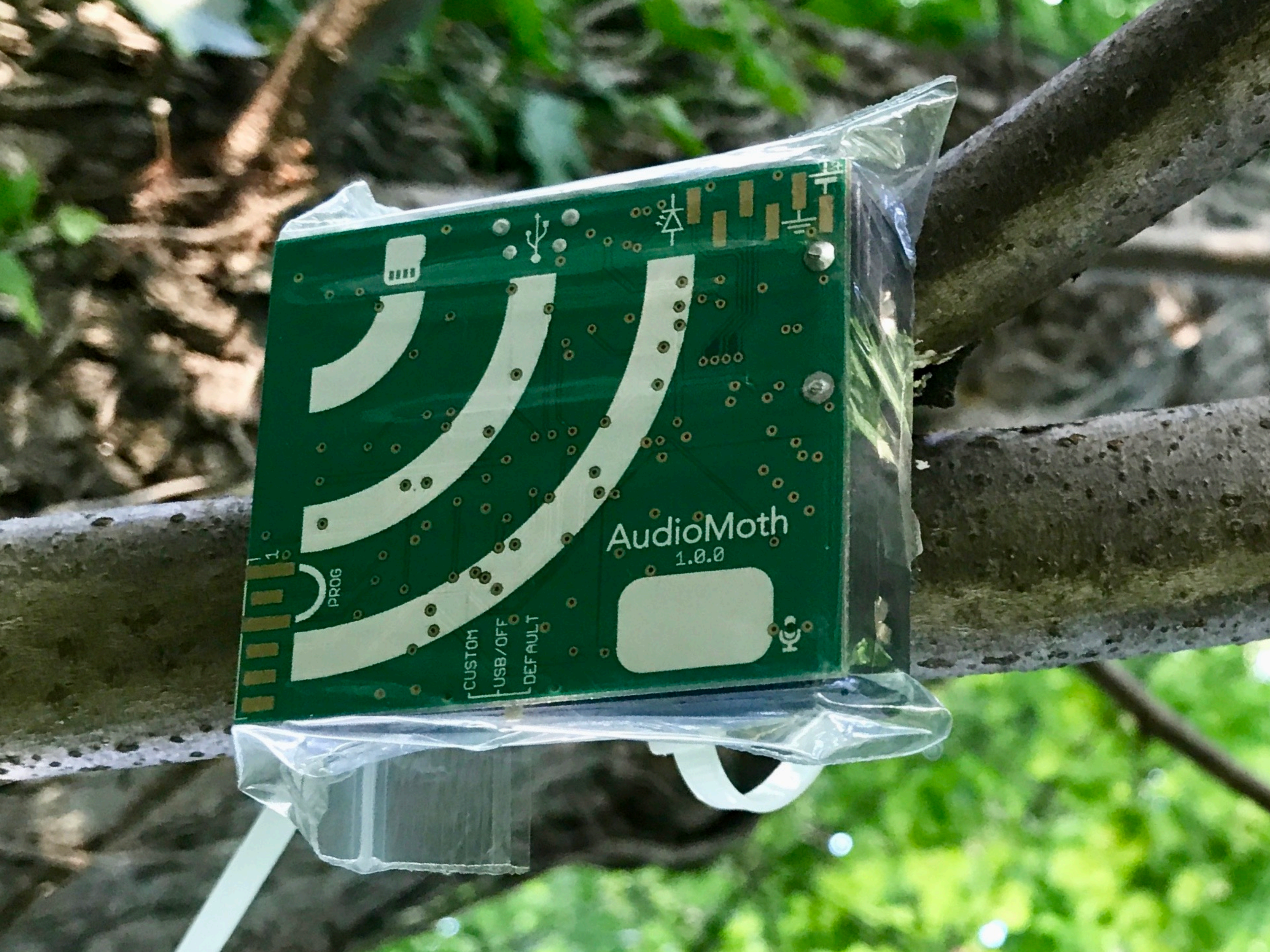
Place your Joulo logger on top of the thermostat in your home, and it will log the temperature continuously for one week.

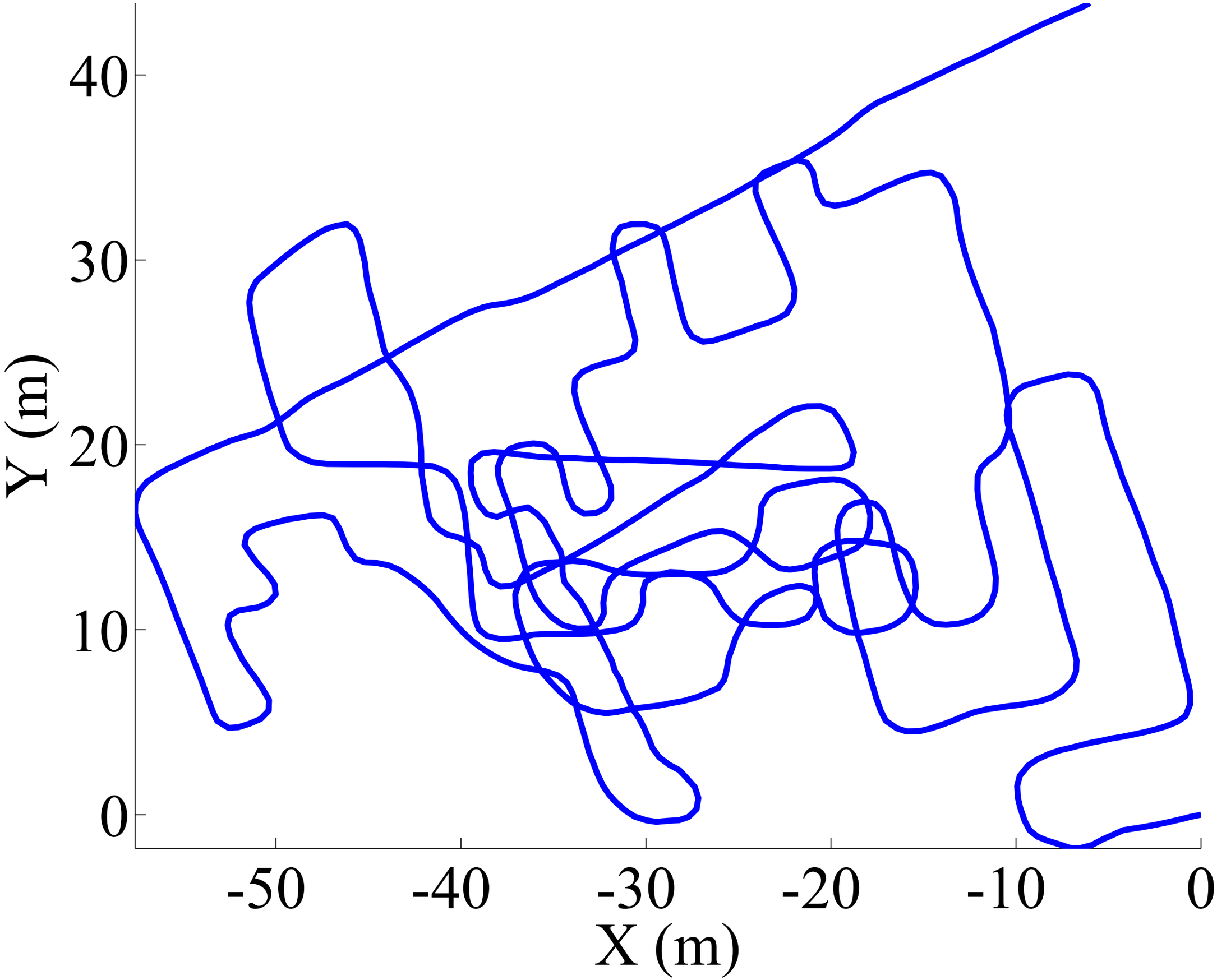


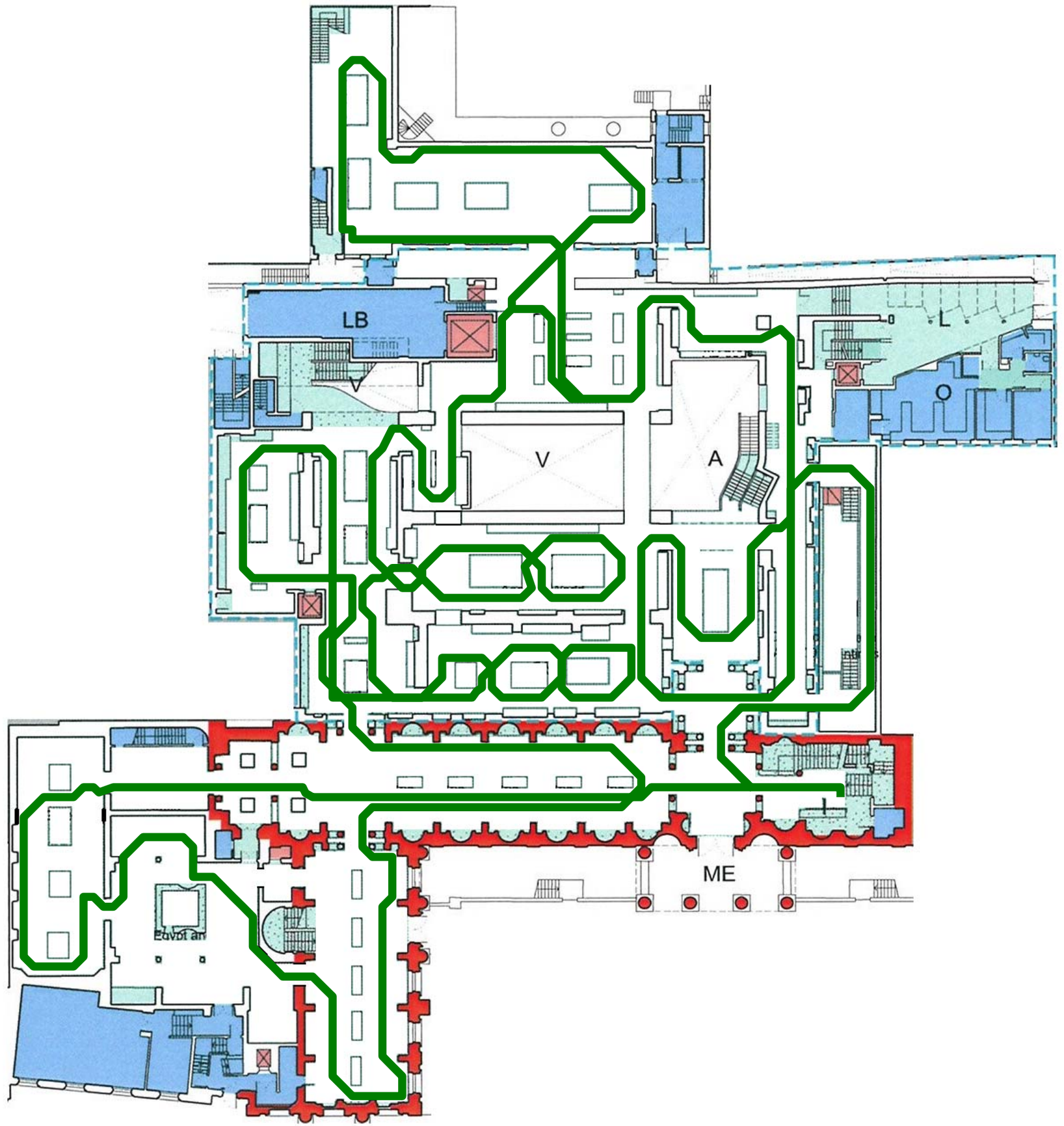
View your usage

3

Upload the data from the logger here, and you'll receive personalised advice on how you can reduce your heating bill.


AudioMoth
1.0.0
PROG
CUSTOM
USB/OFF
DEFAULT


40
30
20
10
0
Y (m)
-50
-40
-30
-20
-10
0
X (m)


LB
V
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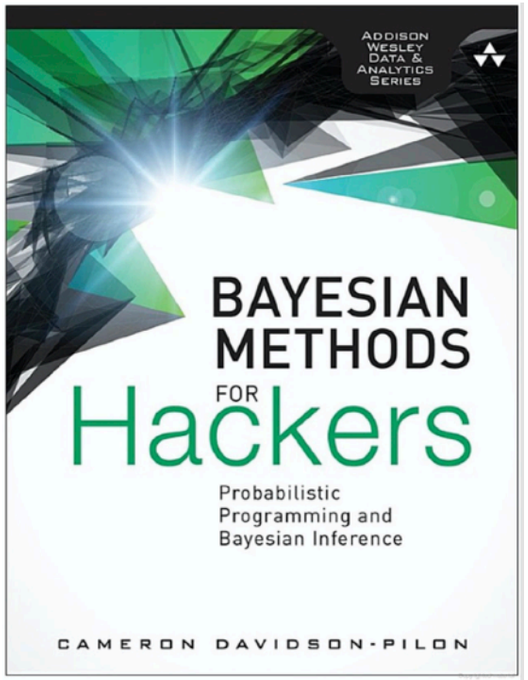
V
A
ME

Probabilistic Machine Learning

1. To understand the fundamentals of probability theory, Bayes rule and Bayesian inference.

2. To understand how to use PyMC, a powerful probabilistic programming framework based on Python, to build sophisticated probabilistic models.

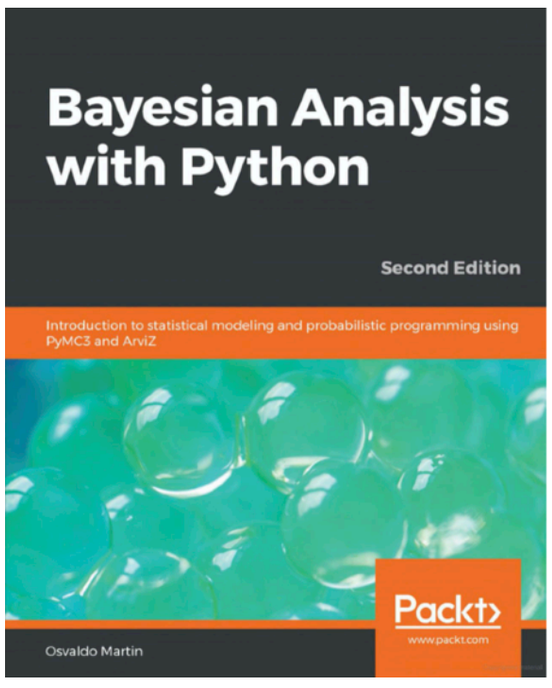
3. To develop experience applying these models to solve real-world machine learning and data analysis tasks.



Probabilistic Programming and Bayesian Methods for Hackers

Cameron Davidson-Pilon

https://camdavidsonpilon.github.io/Probabilistic-Programming-and-Bayesian-Methods-for-Hackers/



Bayesian Analysis with Python

Osvaldo Martin

GitHub

https://github.com/AlexRogersCS/probabilistic_machine_learning

PyMC

https://docs.pymc.io

Google Colab Notebooks

https://colab.research.google.com/

Where are we going?

Vaccine Efficacy

Pfizer: Over 43,000 participants got the two doses of the vaccine or placebo. The same number of subjects was assigned to the treatment and control group. An efficacy of 95% implies that among 170 confirmed cases of COVID-19, 8 of them observed in the vaccine group.

Moderna: The vaccine is being tested in 30,000 people. Half received two doses of the vaccine, and half received a placebo. Of the 95 cases of covid-19, 90 were in the group that received the placebo.

AstraZeneca regimen 1: Regimen 1(first a half dose and at least a month later a full dose) with 2742 participants showed 90% efficacy implies that among 37 confirmed cases of COVID-19, 3 of them observed in the vaccine group.

AstraZeneca regimen 2: Regimen 2 (two full doses at least one month apart) with 8896 participants showed 62% efficacy implies that among 94 confirmed cases of COVID-19, 26 of them observed in the vaccine group.

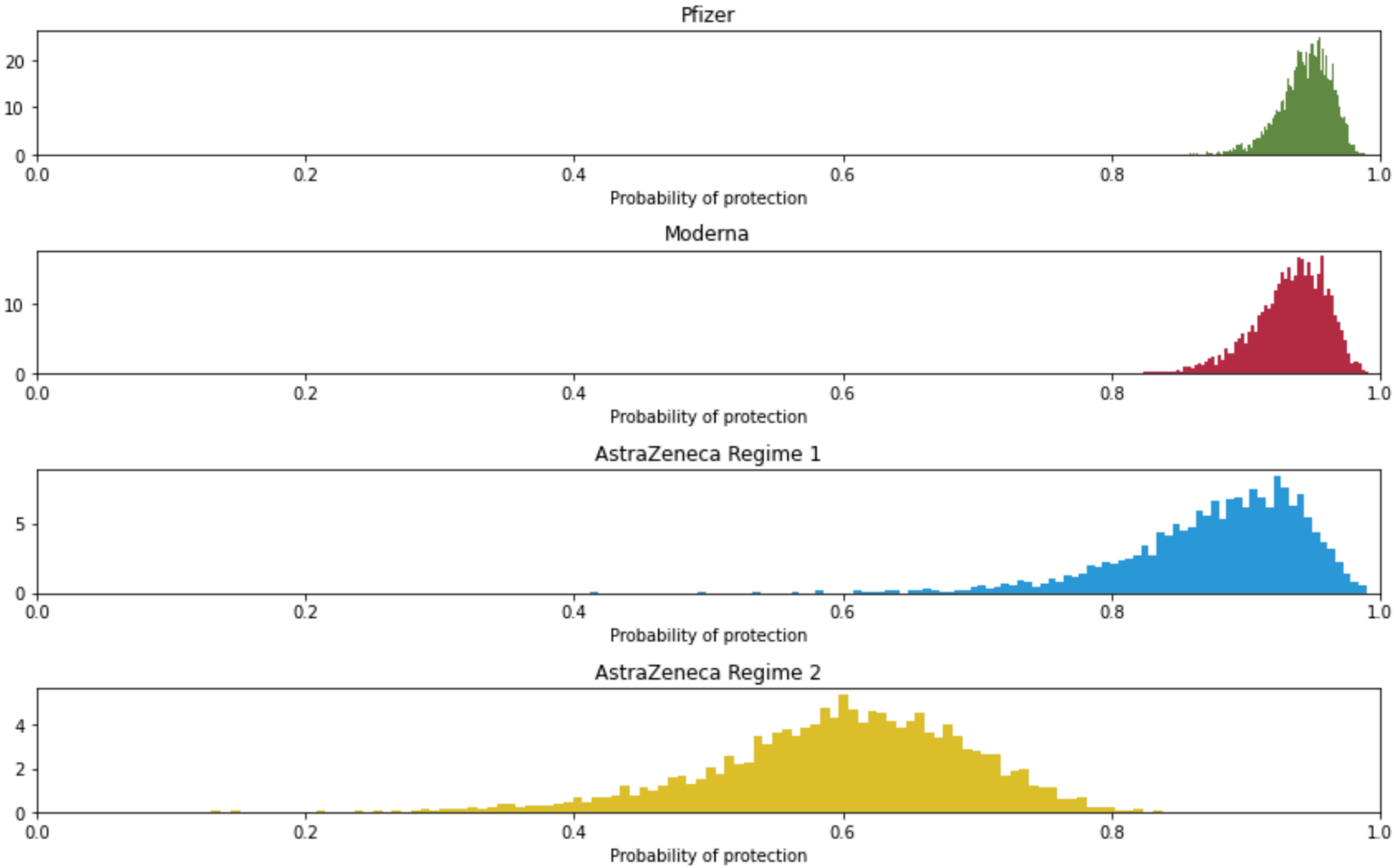
Vaccine Efficacy

Assume some unknown probability that trial participants exposed to infection will test positive during the trial.

Assume that those given the vaccine have the same risk of exposure but will only test positive if the vaccine fails to protect them.

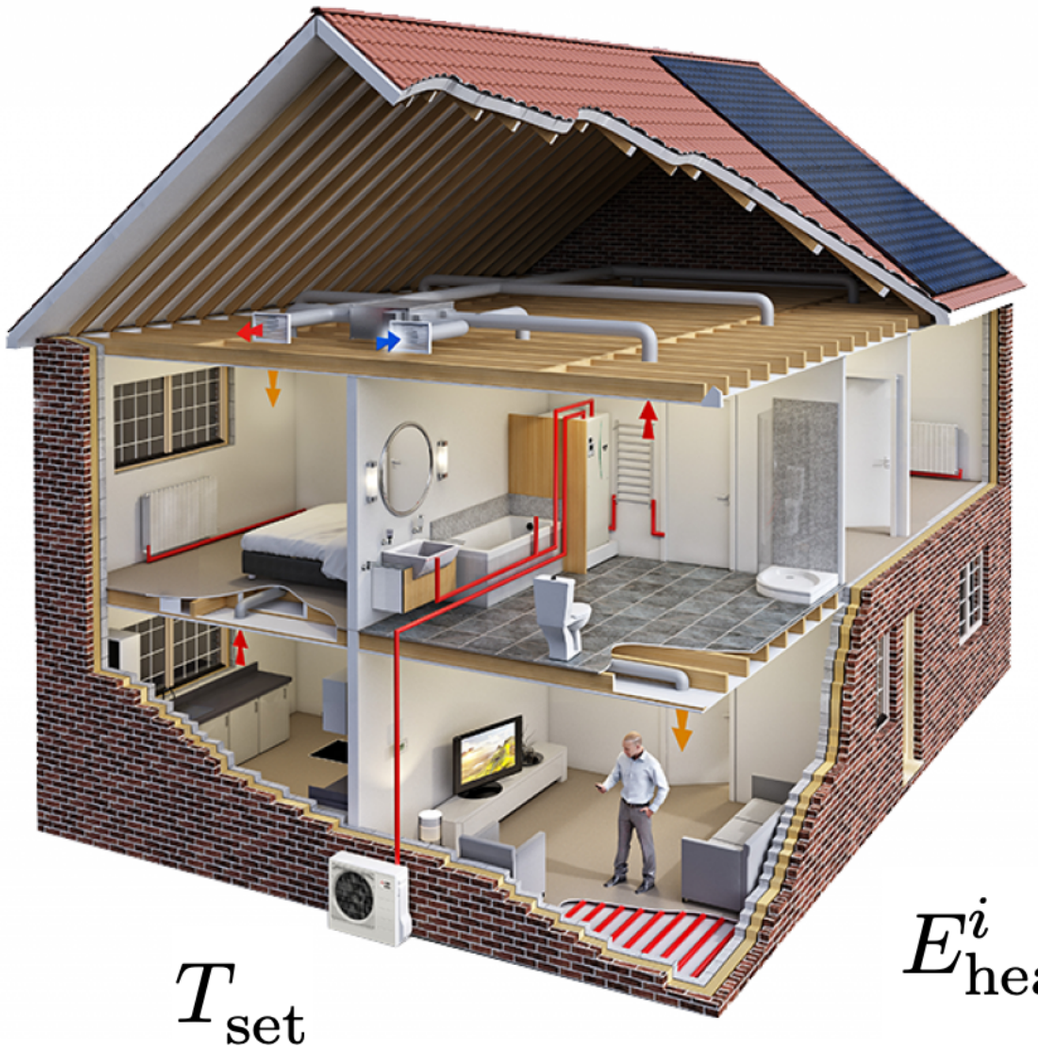
What is the probability of protection of each vaccine?

Vaccine Efficacy



An AI to Help Reduce Heating Bills

T^i_{ext}



T_{set}

$$24 \times \text{HPLC} \times \left(T_{\text{set}} - T^i_{\text{ext}}\right)$$

E^i_{heat}

$$E^i_{\text{heat}} = 24 \times \text{HPLC} \times \left(T_{\text{set}} - T^i_{\text{ext}}\right)$$

Heating off $\quad E^i_{\text{meter}} = E^i_{\text{app}} \qquad T^i_{\text{ext}} > T_{\text{set}}$

Heating on $\quad E^i_{\text{meter}} = E^i_{\text{heat}} + E^i_{\text{app}} \qquad T^i_{\text{ext}} \leq T_{\text{set}}$

An AI to Help Reduce Heating Bills