THE FUTURE OF EMPLOYMENT

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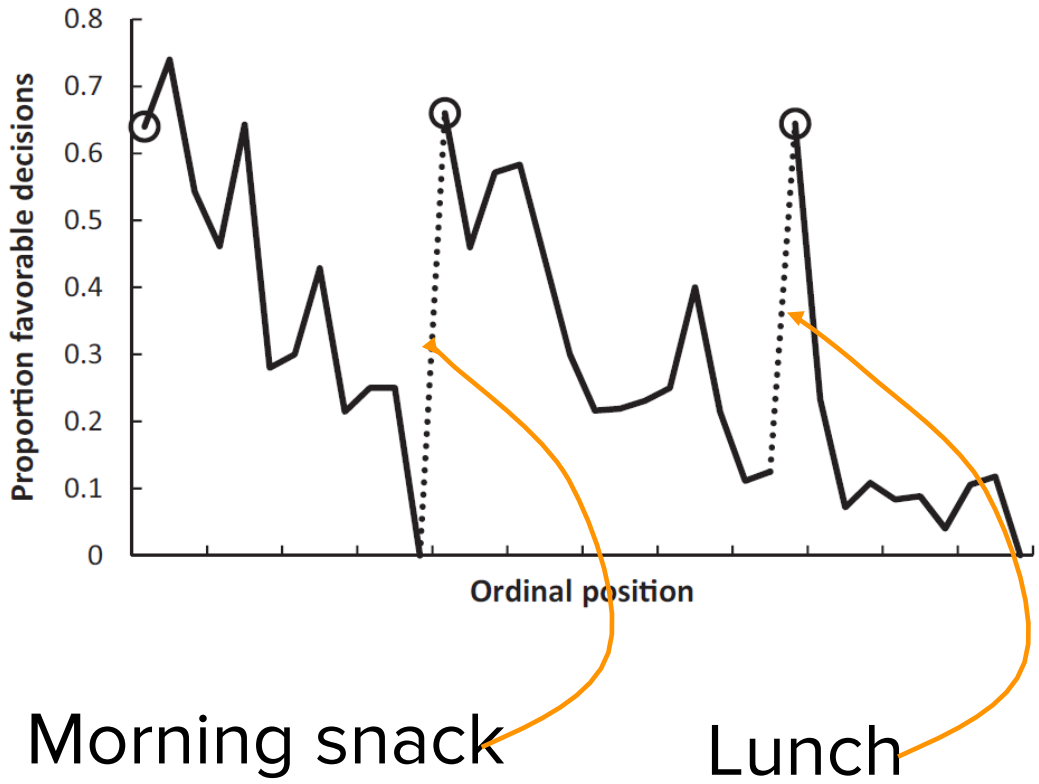
Machine Learning is the study of algorithms that can learn and act.



Israeli judges are significantly more lenient after a food break (Danziger et al 2011).

Algorithms offer decisions free from human heuristics and biases.

Algorithms are also scalable: you can fit more processors than humans into a room.

‘Computer’
c1949

Cheap computing and data is leading to algorithms for increasingly sophisticated tasks, including translation.

Google Translate

Break through language barriers.

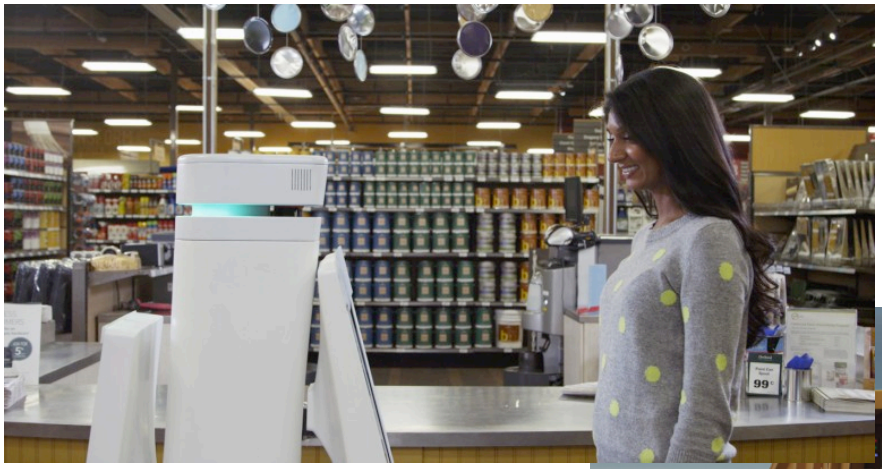
Big data analysis is automating paralegal, contract law and patent law tasks.

“a lot of people who used to be allocated to conduct document review are no longer able to be billed out,” [NYTimes, 2011].

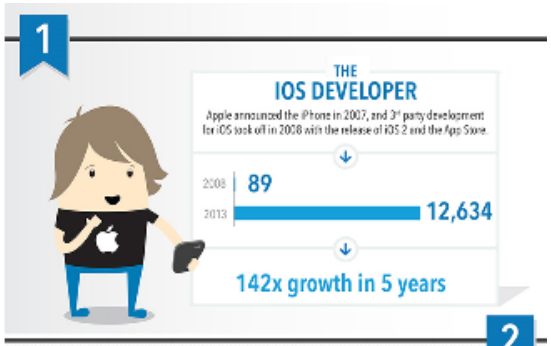
Existing mass-production cars possess computers, sensor networks and safety systems: automation just requires supplying the right algorithm.

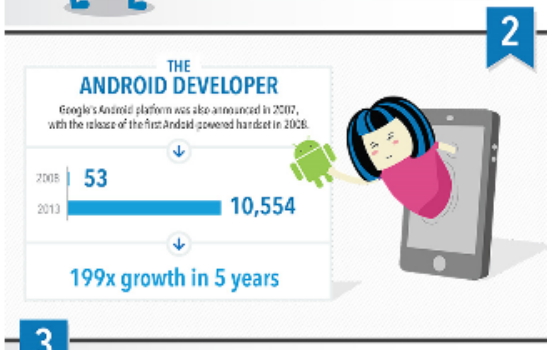
```
module GPyFITC
import PyCall
PyCall.@pyimport GPy
export FITCModel, observe!, infer!, predict
type FITCModel
    model
    n::Int
    X::Array{Float64, 2}
    y::Array{Float64, 1}
end
function FITCModel(lb, ub, n=10)
    u = linspace(lb, ub, n)
end

function observe!(m::FITCModel, X, y)
    if size(m.X) == (0,0)
        m.X = X
        m.y = y
    else
        m.X = vcat(m.X, X)
        m.y = vcat(m.y, y)
    end
    n = size(m.X, 1)
    m.model = GPy.models[:SparseGPRegression](m.X, reshape(m.y, (n, 1)),
        num_inducing=m.n)
end

function infer!(m::FITCModel)
    m.model[:constrain_positive](" ")
    m.model[:optimize]("tnc", max_f_eval=1000)
end

function predict(m::FITCModel, Xp)
    mean, variance = m.model[:predict](Xp)
    variance = max(variance, 0)
    mean, variance
end
end
```

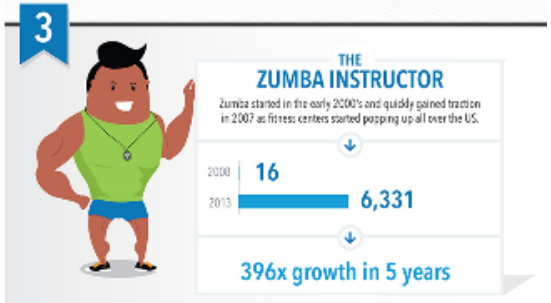
Many logistics tasks are now being automated with the use of machine learning and mobile robotics technologies.

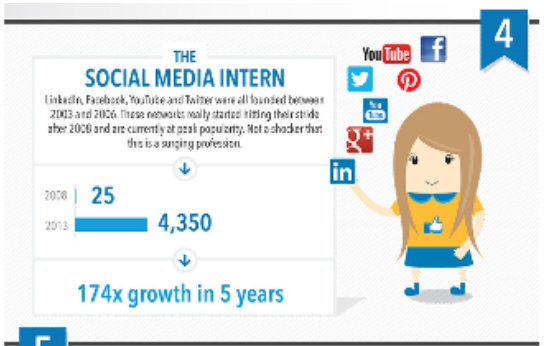


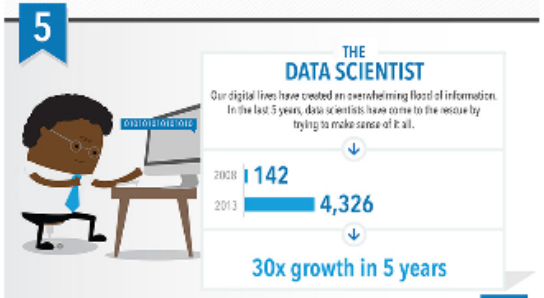
So, if machines can drive, serve customers, and look through data, what are humans still good for? We suggest:
creativity, social intelligence and manipulation.

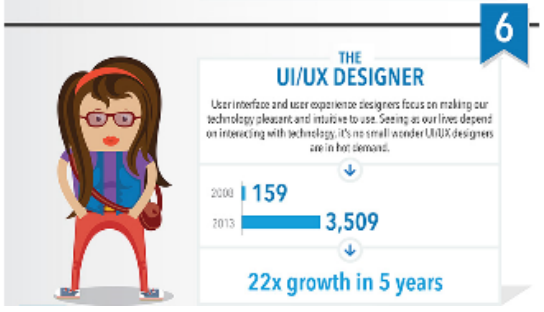


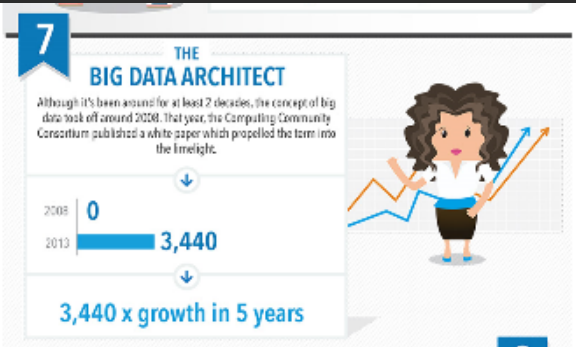


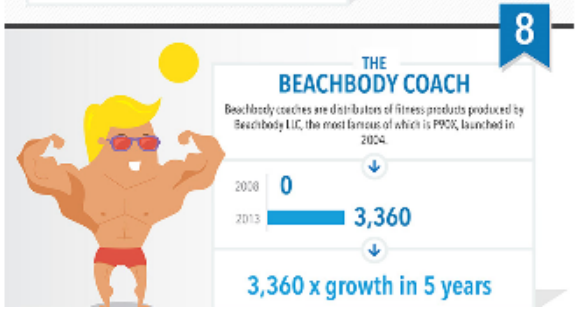






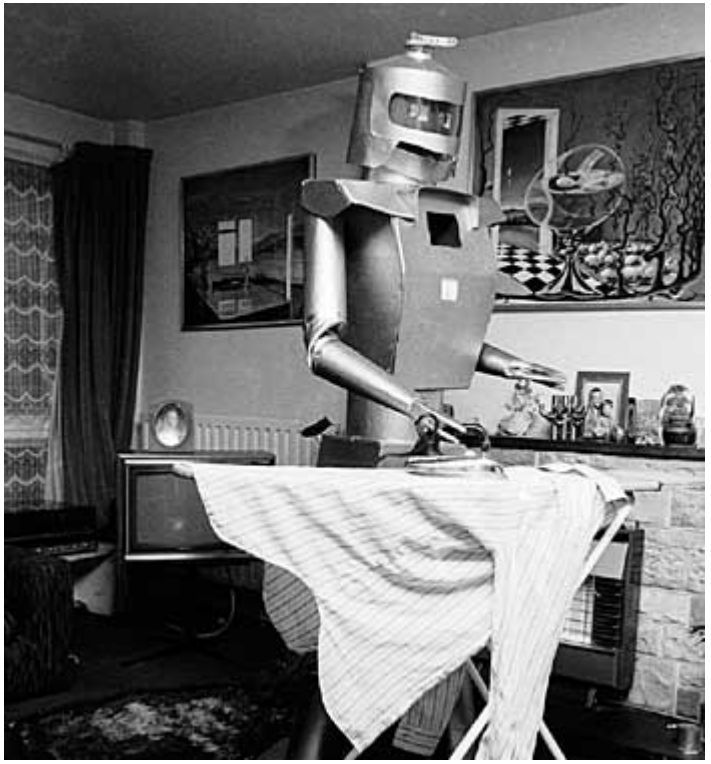




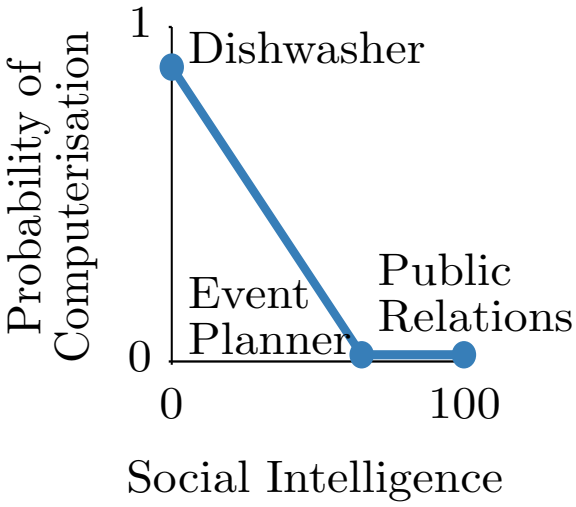


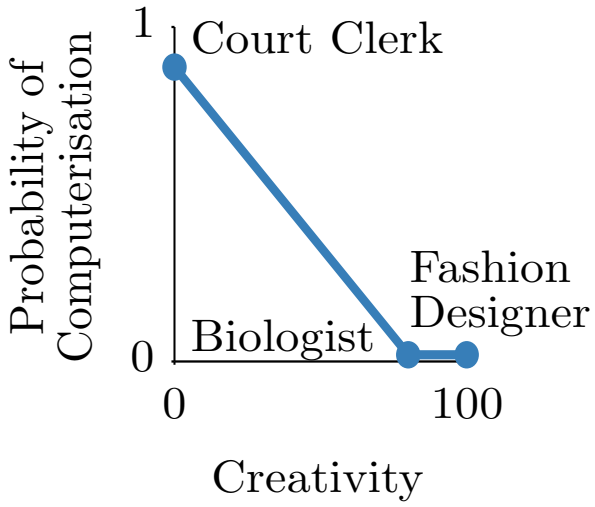
Precisely, autonomous manipulation in unstructured environments is difficult to automate.

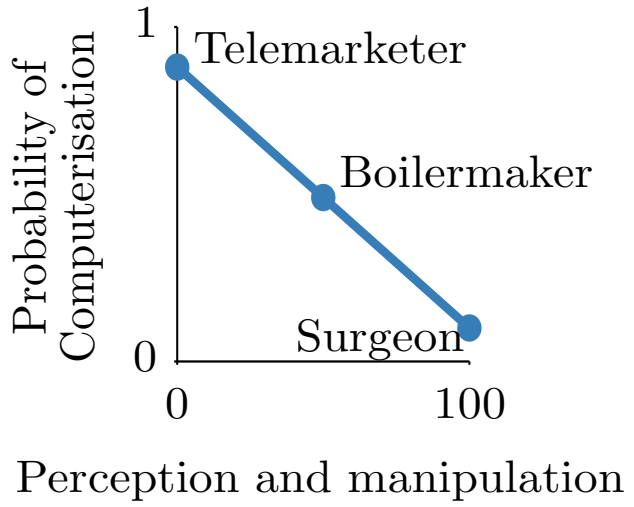
amazon.com®



We take a job's automatability to be a function of the skills required to complete the task.

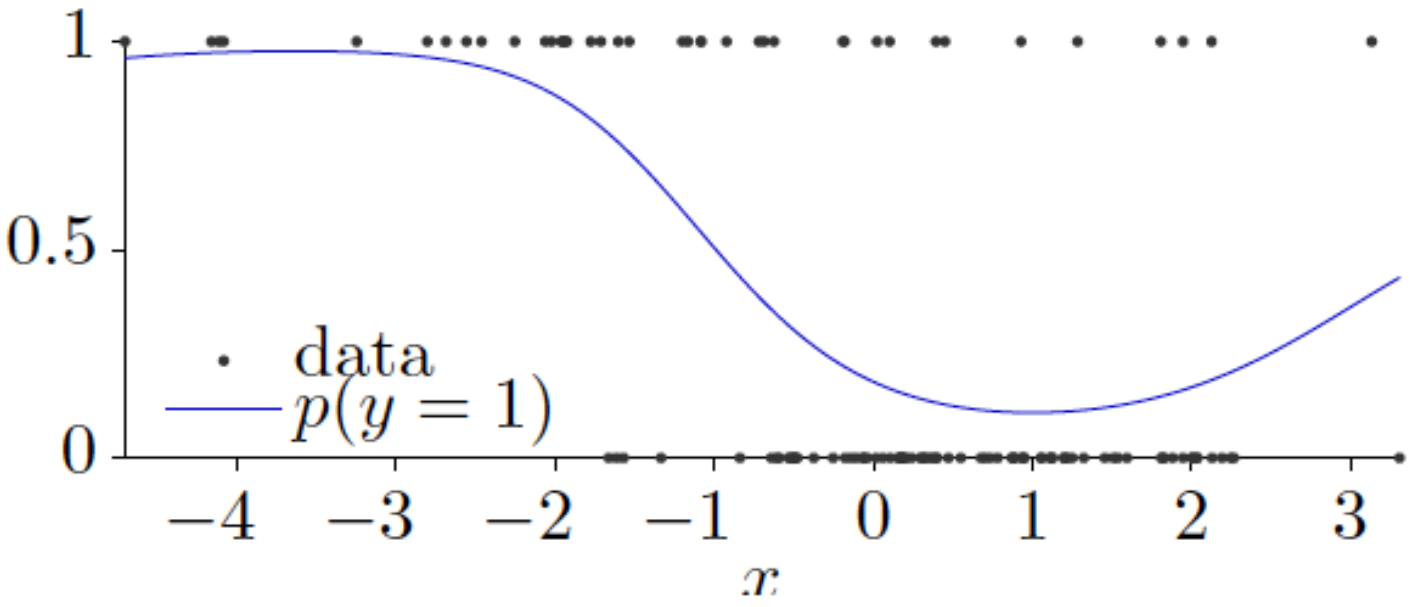






We used a dataset of 702 occupations, for which we have employment, income and skills related to automatability (e.g. finger dexterity, originality and persuasion).

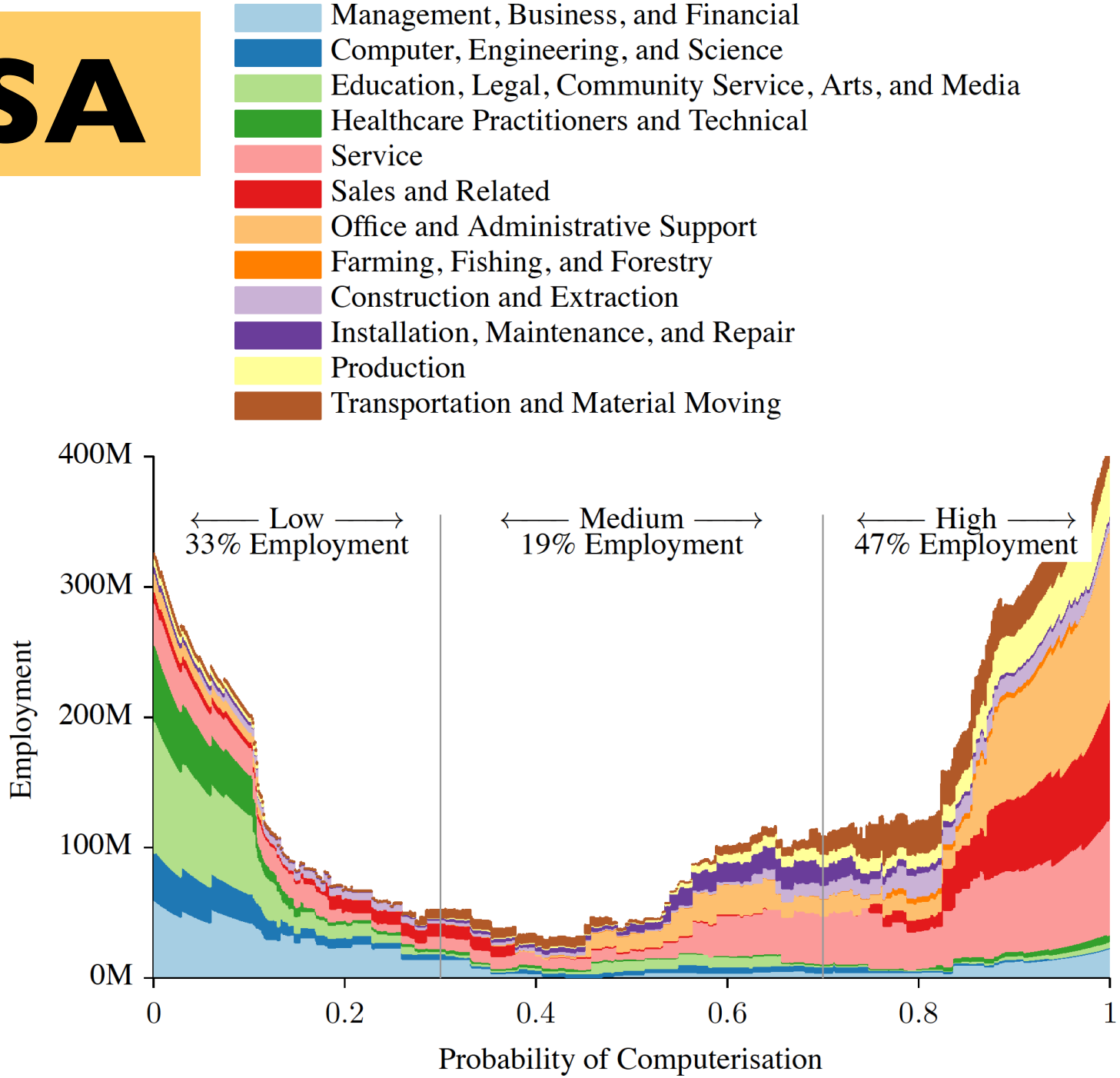
We hand-labelled 70 occupations as being automatable or not. Then we classified the automatability of all occupations.



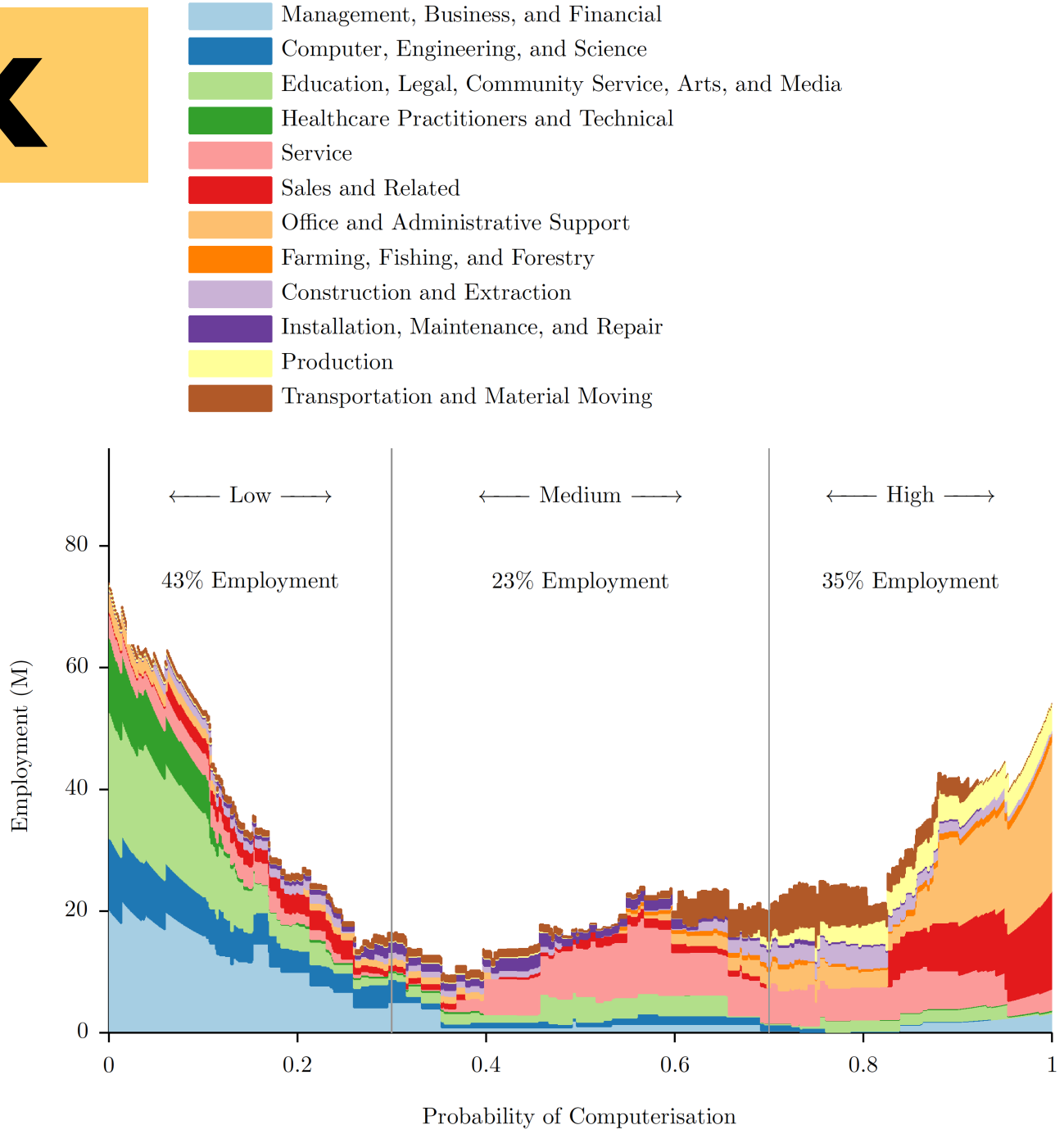
Over 100 random splits, 35 of these occupations were able to predict the other 35 with high accuracy: suggesting insensitivity to the choice of the 70.

Occupation	Label	Probability
Data Entry Keyers	1	0.99
Tax Preparers		0.99
Umpires and Referees		0.98
Industrial Truck Operators	1	0.94
Waiters and waitresses	0	0.94
Slaughterers		0.60
Economists	0	0.43
Judicial Law Clerks	1	0.41
Clergy	0	0.01
Choreographers		0.00

USA


Management, Business, and Financial
Computer, Engineering, and Science
Education, Legal, Community Service, Arts, and Media
Healthcare Practitioners and Technical
Service
Sales and Related
Office and Administrative Support
Farming, Fishing, and Forestry
Construction and Extraction
Installation, Maintenance, and Repair
Production
Transportation and Material Moving
400M
300M
200M
100M
0M
Employment
Low
33% Employment
Medium
19% Employment
High
47% Employment
0
0.2
0.4
0.6
0.8
1
Probability of Computerisation

UK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Computer, Engineering, and Science
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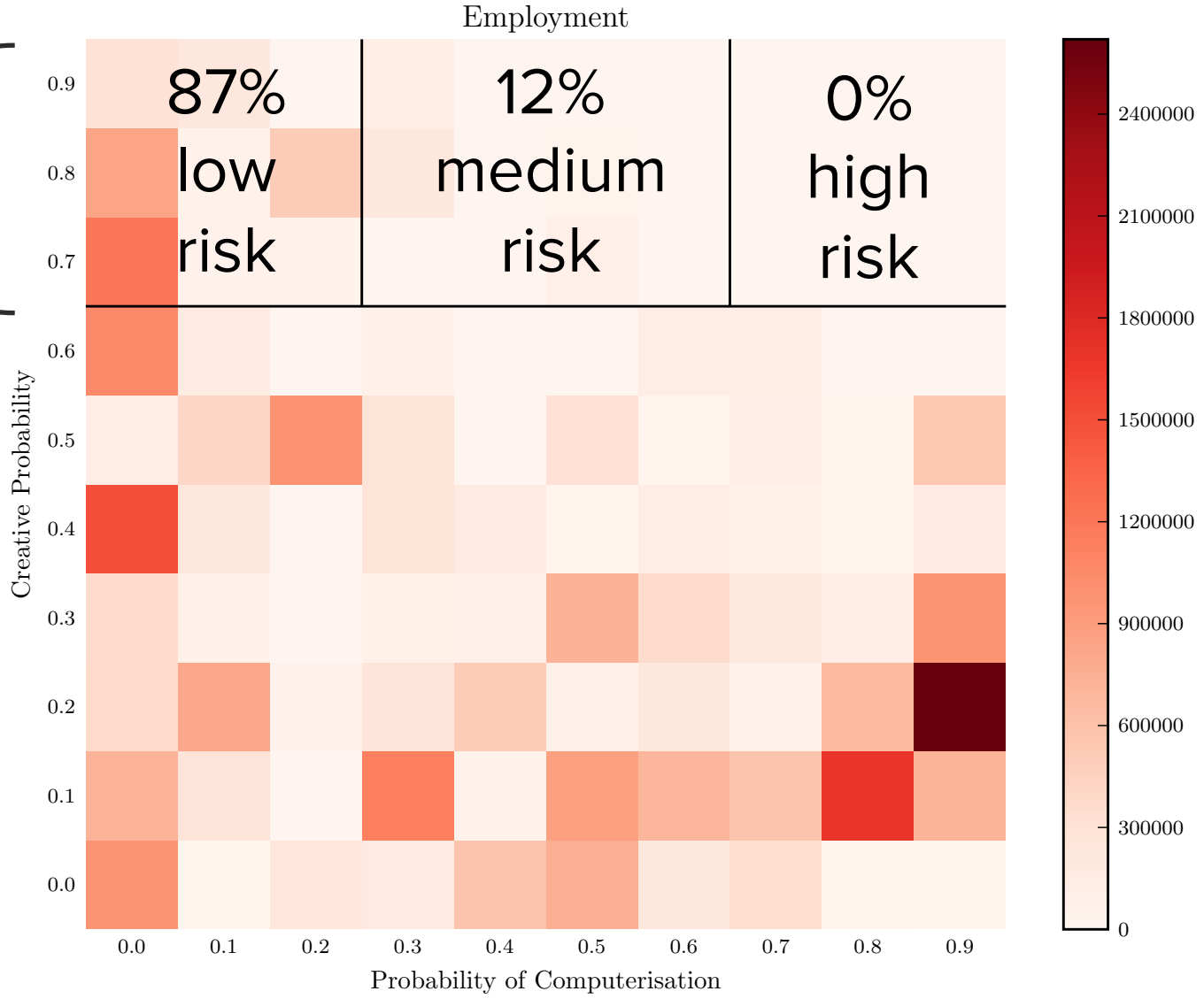
Service
Sales and Related
Office and Administrative Support
Farming, Fishing, and Forestry
Construction and Extraction
Installation, Maintenance, and Repair
Production
Transportation and Material Moving
Low
Medium
High
43% Employment
23% Employment
35% Employment
Employment (M)
0
20
40
60
80
0
0.2
0.4
0.6
0.8
1
Probability of Computerisation

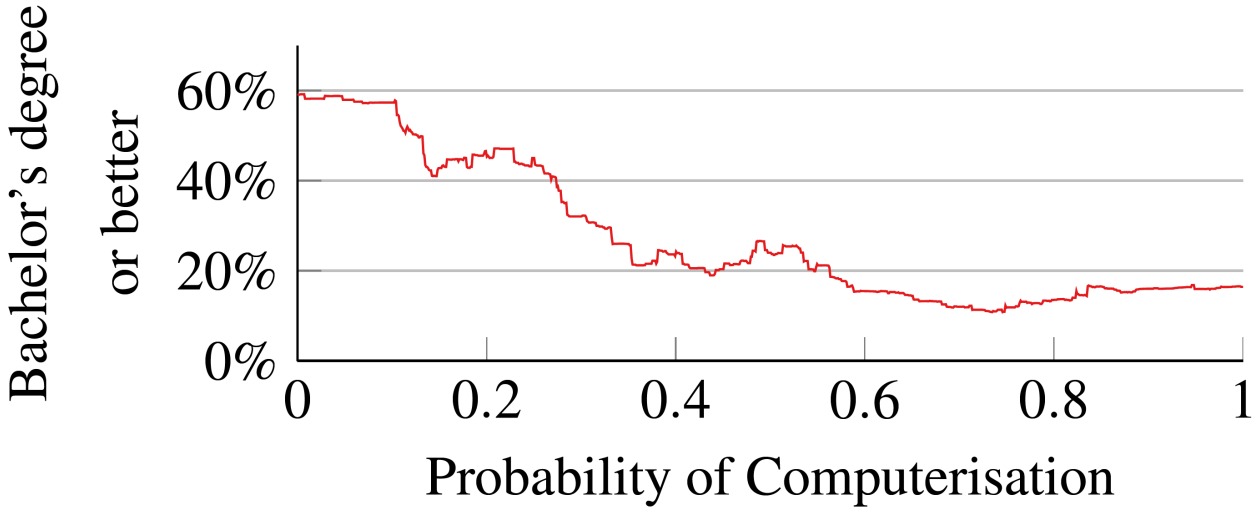
We find creative jobs to be non-automatable.

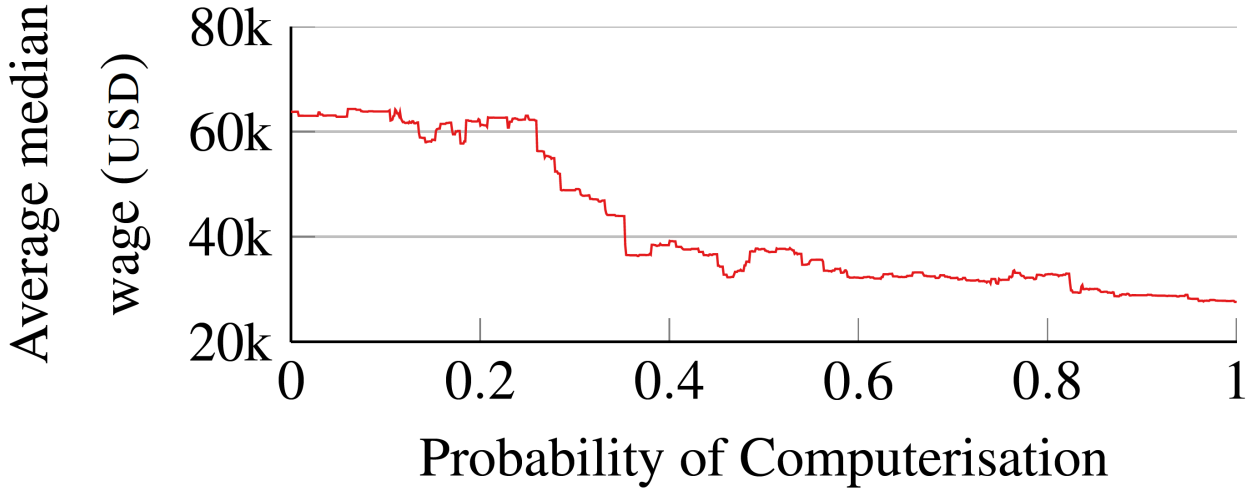
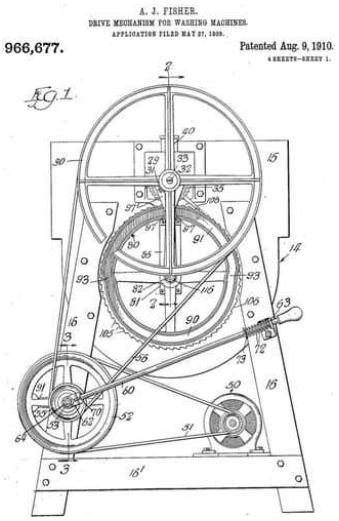
Creative jobs



UK

We predict that high-skilled jobs are relatively resistant to computerisation.





We must ensure that all can share in the great prosperity promised by new technologies.