AI and the challenge of Sustainability: From individuals to data and back

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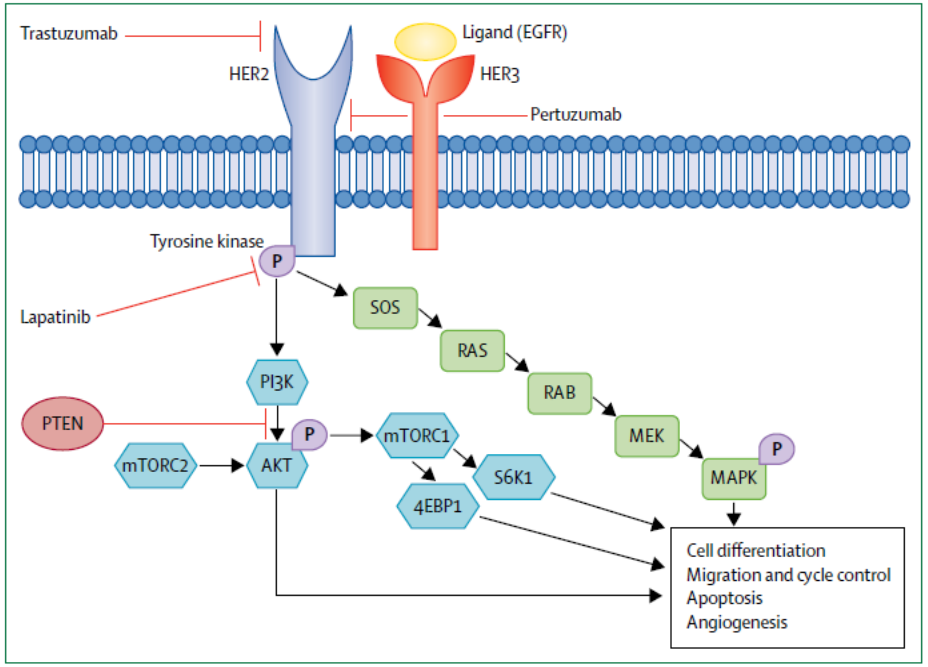
AI for health – Precision medicine

Precision medicine, definition by the NIH - National Cancer Institute:

"*A form of medicine that uses information about a person's own genes or proteins to prevent, diagnose, or treat disease. In cancer, precision medicine uses specific information about a person's tumor to help make a diagnosis, plan treatment, find out how well treatment is working, or make a prognosis. Examples of precision medicine include using targeted therapies to treat specific types of cancer cells, such as HER2-positive breast cancer cells, or using tumor marker testing to help diagnose cancer. Also called* ***personalized medicine***."



- https://www.cancer.gov/publications/dictionaries/cancer-terms/def/precision-medicine
- S. Loibl and L. Gianni, "HER2-positive breast cancer," Lancet, vol. 389, no. 10087, pp. 2415–2429, Jun. 2017, doi: 10.1016/S0140-6736(16)32417-5.

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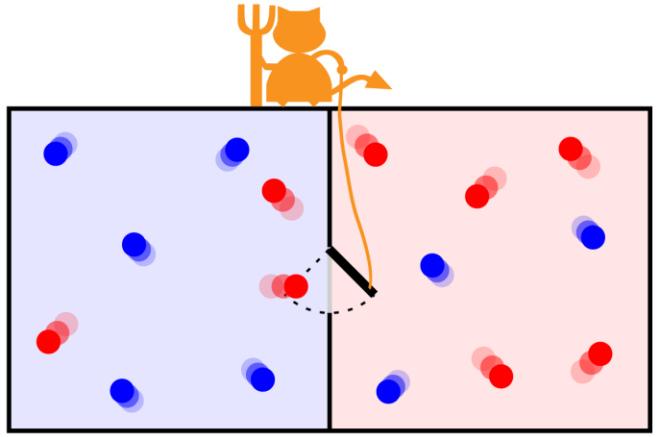
Maxwell demon and the benefit of precision medicine



- J. M. R. Parrondo, J. M. Horowitz, and T. Sagawa, “Thermodynamics of information,” Nat. Phys., vol. 11, no. 2, pp. 131–139, 2015.
- S. Still, D. A. Sivak, A. J. Bell, and G. E. Crooks, “Thermodynamics of Prediction,” Phys. Rev. Lett., vol. 109, no. 12, p. 120604, Sep. 2012.

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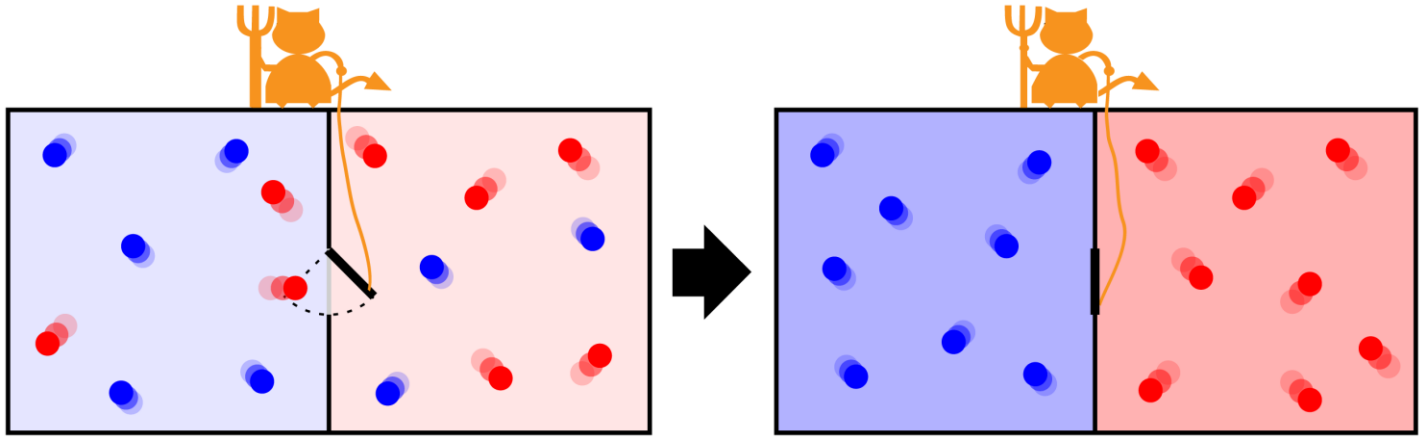

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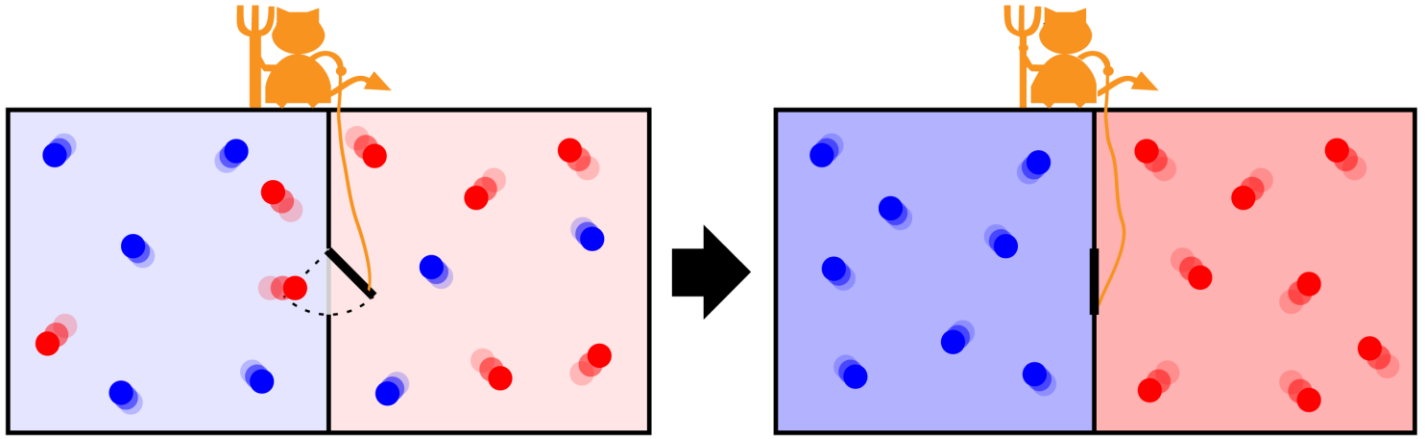

Maxwell demon thought experiment	Precision medicine
Gas	Population
Particle *i*	Person *i*
(x_i, v_i) position and velocity of *i*	Molecular, clinical, or behavioral features of *i*
Macroscopic thermodynamic quantities: pressure, temperature, volume, internal energy...	Population health measures: prevalence rates, incidence rates...
Precision interventions: Maxwell opening and closing the door	Precision interventions: personalized interventions
Entropy decrease	Health gain

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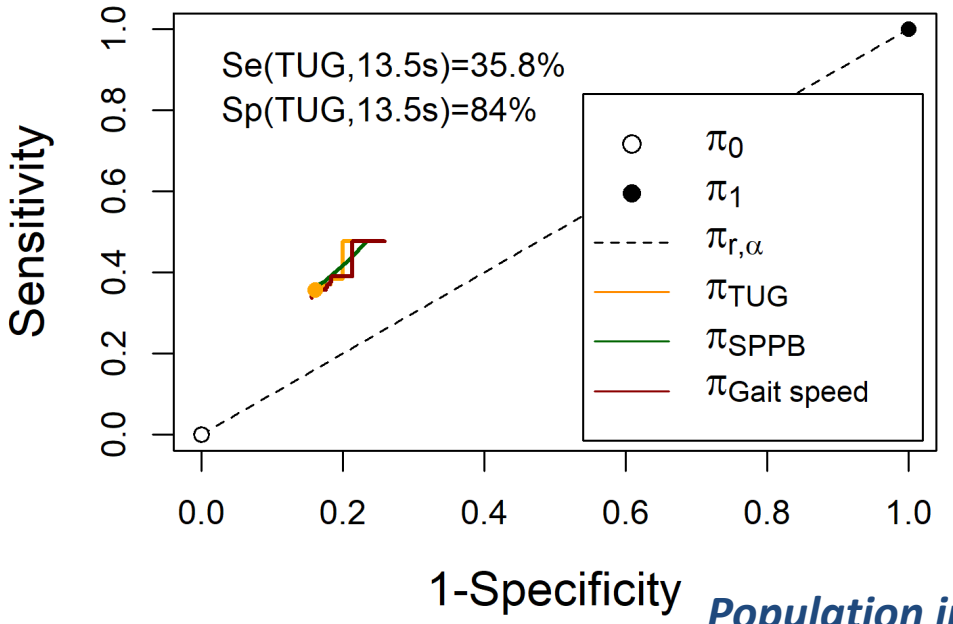
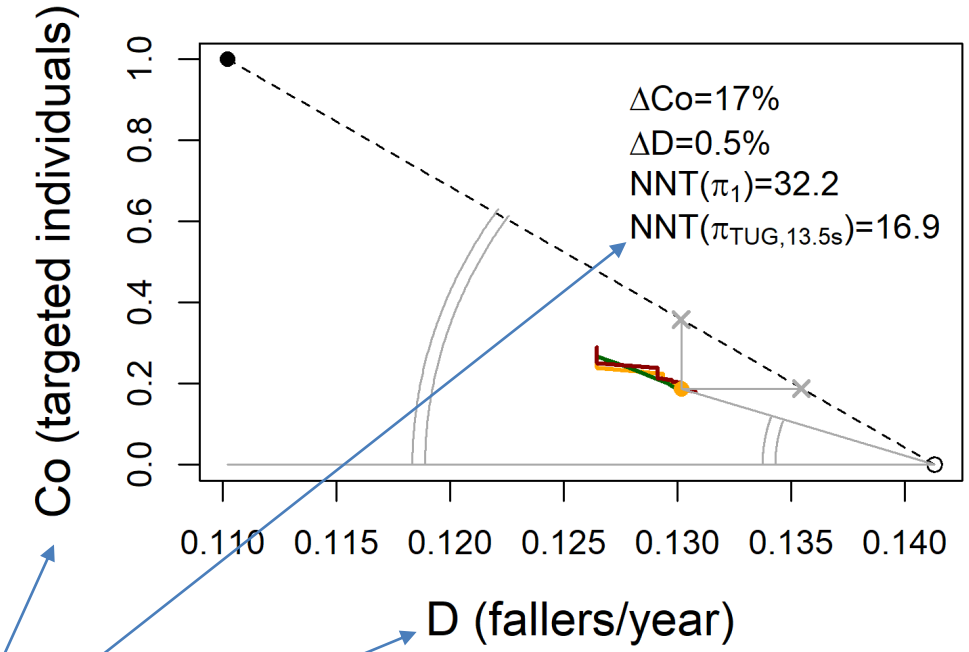
Sustainability – Measuring the impact of predictive tools

ROC for statistical accuracy



CoD for population impact



Population impact measures

Coverage

Number needed to treat

Incidence

- P. Palumbo, C. Becker, S. Bandinelli, and L. Chiari, "Simulating the effects of a clinical guidelines screening algorithm for fall risk in community dwelling older adults," Aging Clin. Exp. Res., pp. 1–8, Oct. 2018.