

Energy-Aware Computing Systems (EASY)

Energy Models

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Timo Hönig, Stefan Reif, Benedict Herzog

Lehrstuhl für Informatik 4
Friedrich-Alexander-Universität Erlangen-Nürnberg



Lehrstuhl für Verteilte Systeme
und Betriebssysteme



FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG

TECHNISCHE FAKULTÄT

- Function: $X \mapsto E$
- Motivation:
 - Measurement simplification
 - Generalisation (interpolation, extrapolation)
 - Prediction
 - Dependency identification
 - Optimisation
 - ...

Precision and Accuracy („Genauigkeit“)



precise but not accurate



accurate but not precise



poor trueness

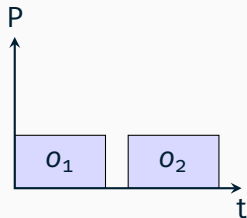
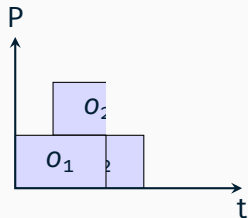
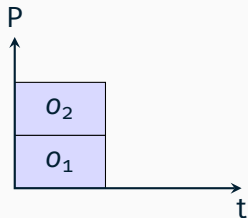


poor precision

Linearity

- Executing operations o_1 and o_2 :

$$E(o_1; o_2) = E(o_1) + E(o_2)$$



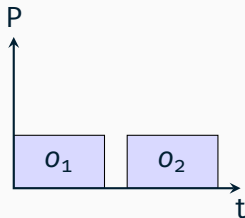
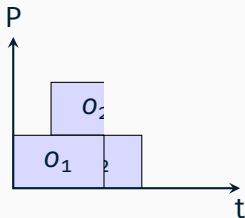
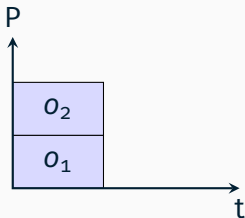
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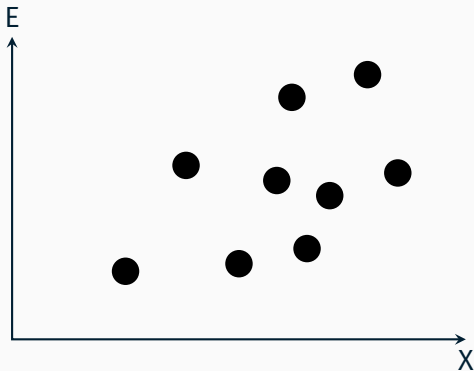
- Generalisation:

$$E(\vec{o}) = E(o_1) + E(o_2) + \dots = n_A E(o_A) + n_B E(o_B) + \dots$$



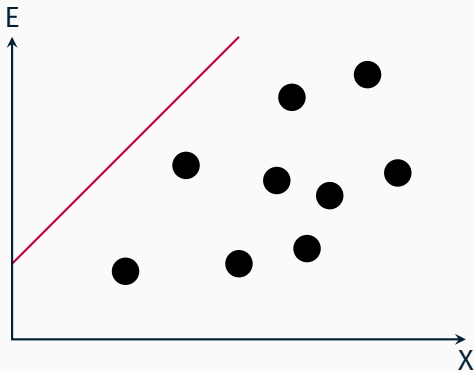
Error minimisation

- Model: parameterised function
- Optimisation problem:
 - Find function parameters that minimise an error metric



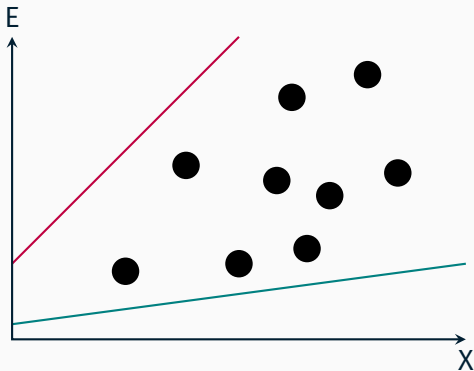
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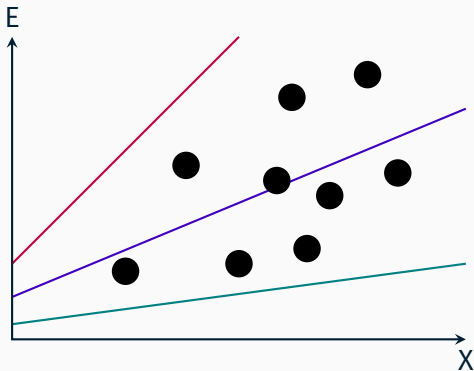
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Error minimisation

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- Given: Measurements $\langle x_i, y_i \rangle$
- Goal: create a model $\forall i : y_i \approx \alpha x_i + \beta$
- Task: find best values for α and β (least-squares)
- ...

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$$\alpha = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^n (x_i - \bar{x})^2}$$

$$\beta = \bar{y} - \alpha \bar{x}$$

- ... where ...

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

$$\bar{y} = \frac{1}{n} \sum_{i=1}^n y_i$$

- Given: Measurements $\langle x_{A,i}, x_{B,i}, \dots, y_i \rangle$
- Model: $\forall i : y_i \approx \mu_A x_{A,i} + \mu_B x_{B,i} + \dots$
- ...

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- Model: $\forall i : y_i \approx \mu_A x_{A,i} + \mu_B x_{B,i} + \dots$
- ...
- Solve $X\vec{\mu} \approx \vec{y}$ for $\vec{\mu} = \langle \mu_A, \mu_B, \dots \rangle$
- ...

- Given: Measurements $\langle x_{A,i}, x_{B,i}, \dots, y_i \rangle$
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...
- Solve $X\vec{\mu} \approx \vec{y}$ for $\vec{\mu} = \langle \mu_A, \mu_B, \dots \rangle$
...
- Solve $X^T X \vec{\mu} = X^T \vec{y}$ for $\vec{\mu}$ (least-squares)