Gaussian mixture

assume to be
$\approx$ Gaussian

by Thm 1[2]

predictive semantic posterior

physical likelihood

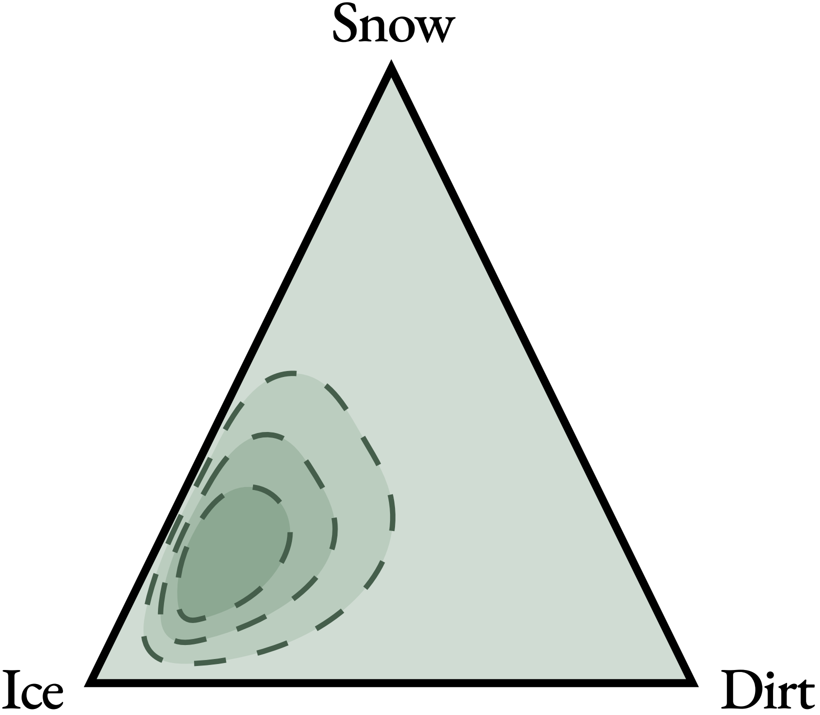
Key idea: Construct a conditional probability distribution to estimate physical properties based on semantic segmentation, as in [Ewan, P., et al. (2022)]*, [Nguyen, T., et al. (2021)]

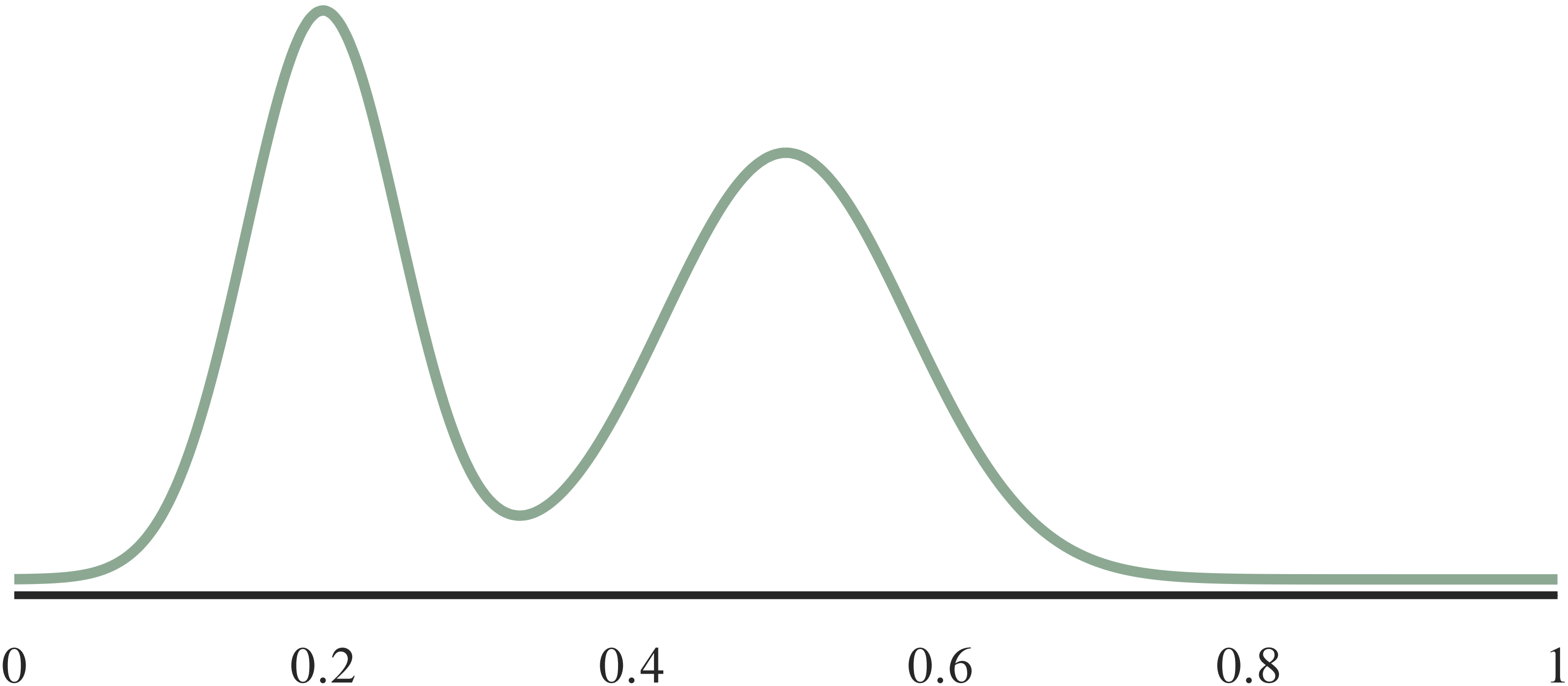
Update measurements with semantics

$$p(\boldsymbol{\psi} \mid \mathcal{Z}, \boldsymbol{\alpha}) = \sum_{i=1}^{k} p(z = i \mid \mathcal{Z}, \boldsymbol{\alpha}) \cdot p(\boldsymbol{\psi} \mid z = i)$$

$$= \sum_{i=1}^{k} \frac{\alpha_i}{\sum_{j=1}^{k} \alpha_j} \cdot \mathcal{N}(\mu_i, \sigma_i^2)$$

Physical estimation given semantic data
$\mathcal{Z}$


Snow
Ice
Dirt


0
0.2
0.4
0.6
0.8
1

parameters of the Dirichlet prior

2. [Tu, S. *The Dirichlet-Multinomial and Dirichlet-Categorical models for Bayesian inference*.]

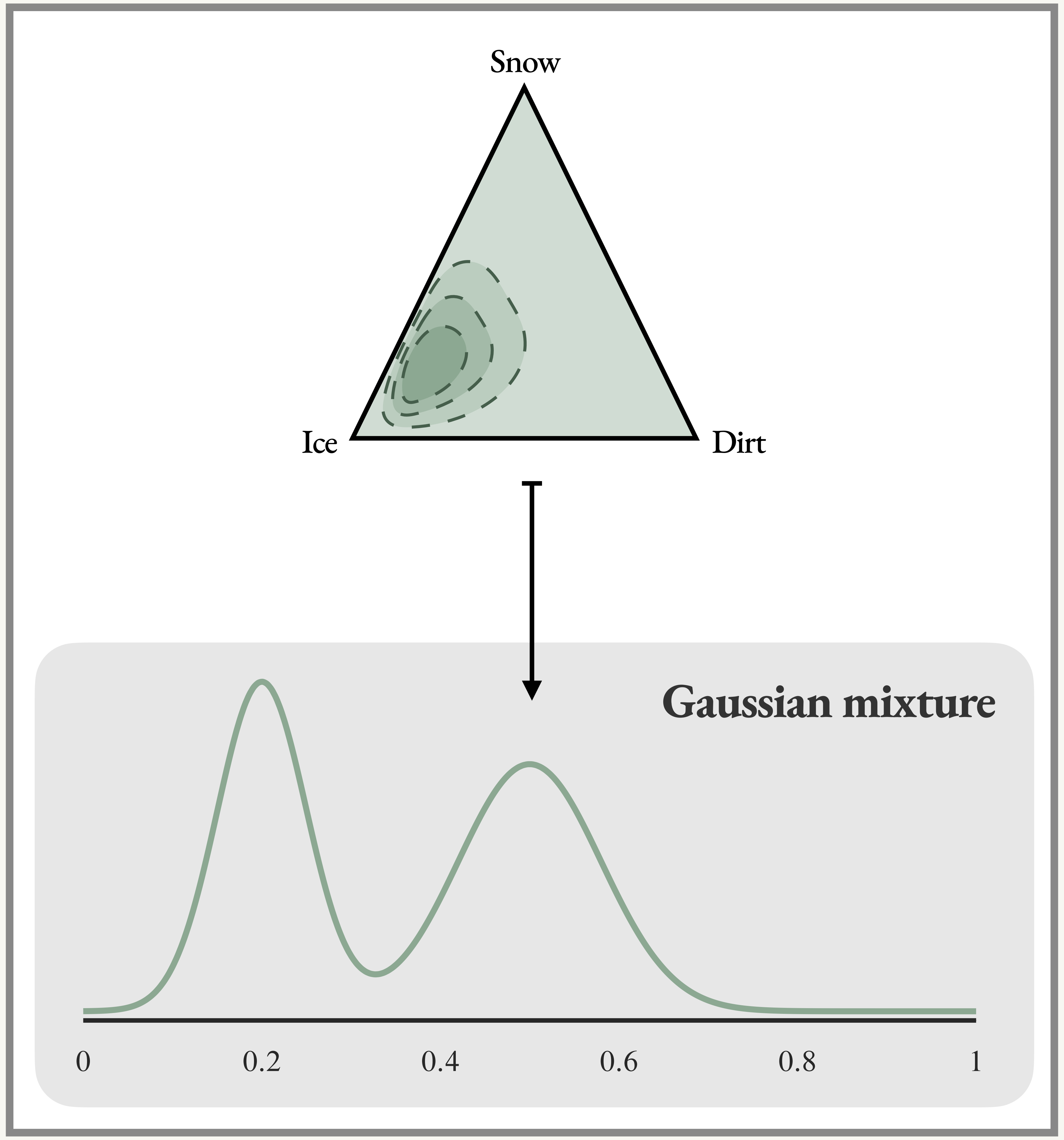
Update measurements with semantics

Key idea: Construct a conditional probability distribution to estimate physical properties based on semantic segmentation, as in [Ewan, P., et al. (2022)]*, [Nguyen, T., et al. (2021)]

parameters of the Dirichlet prior

$$\underbrace{p(\boldsymbol{\psi} \mid \mathcal{Z}, \boldsymbol{\alpha})}_{\text{Physical estimation given semantic data } \mathcal{Z}} = \sum_{i=1}^{k} \underbrace{p(z = i \mid \mathcal{Z}, \boldsymbol{\alpha})}_{\text{predictive semantic posterior}} \cdot \underbrace{p(\boldsymbol{\psi} \mid z = i)}_{\text{physical likelihood}}$$

$$= \sum_{i=1}^{k} \underbrace{\frac{\alpha_i}{\sum_{j=1}^{k} \alpha_j}}_{\text{by Thm } 1^2} \cdot \underbrace{\mathcal{N}(\mu_i, \sigma_i^2)}_{\text{assume to be } \approx \text{ Gaussian}}$$



2. [Tu, S. *The Dirichlet-Multinomial and Dirichlet-Categorical models for Bayesian inference.*]

Physical conjugate(?) prior