



16TH EUROPEAN CONFERENCE ON  
**COMPUTER VISION**

[WWW.ECCV2020.EU](http://WWW.ECCV2020.EU)





# Energy-Based Models for Deep Probabilistic Regression

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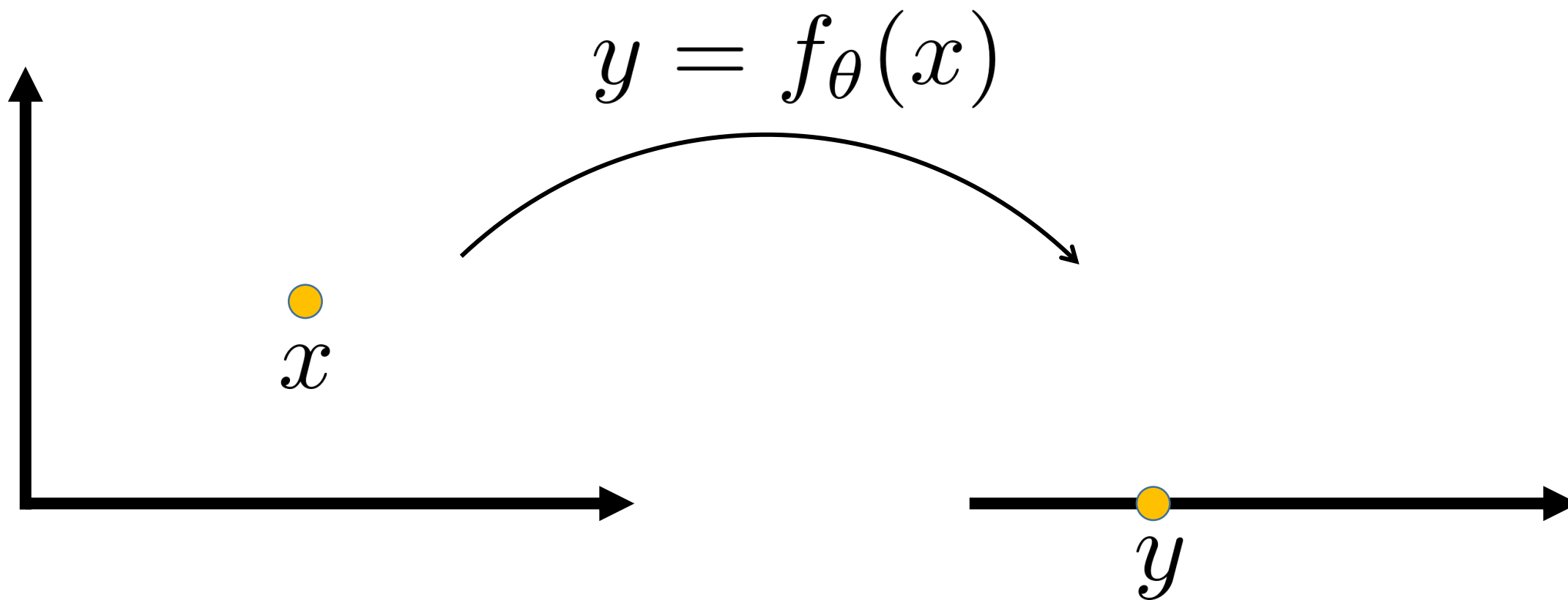
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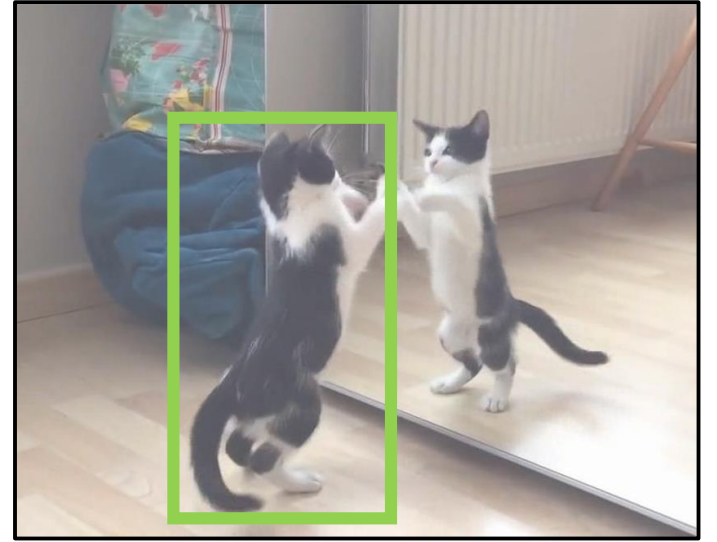
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# Direct Regression:



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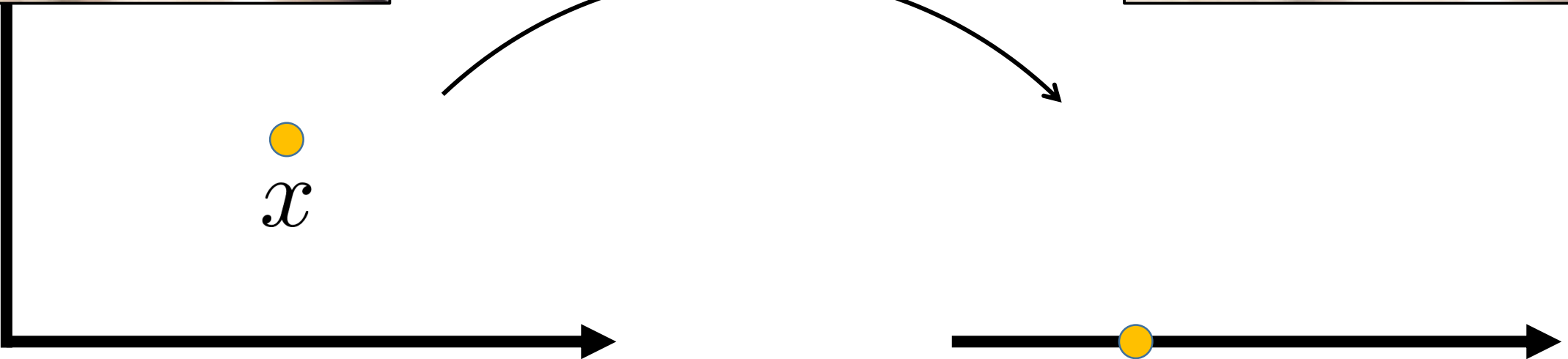
Example: bounding box regression.



$$y = f_{\theta}(x)$$

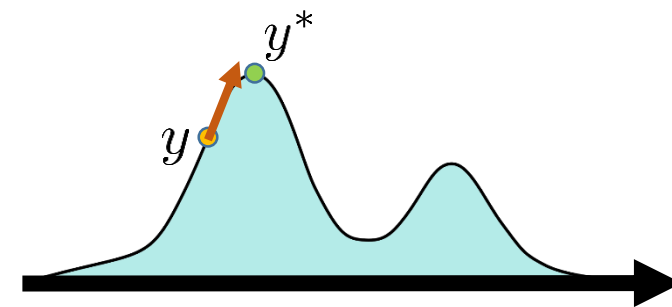
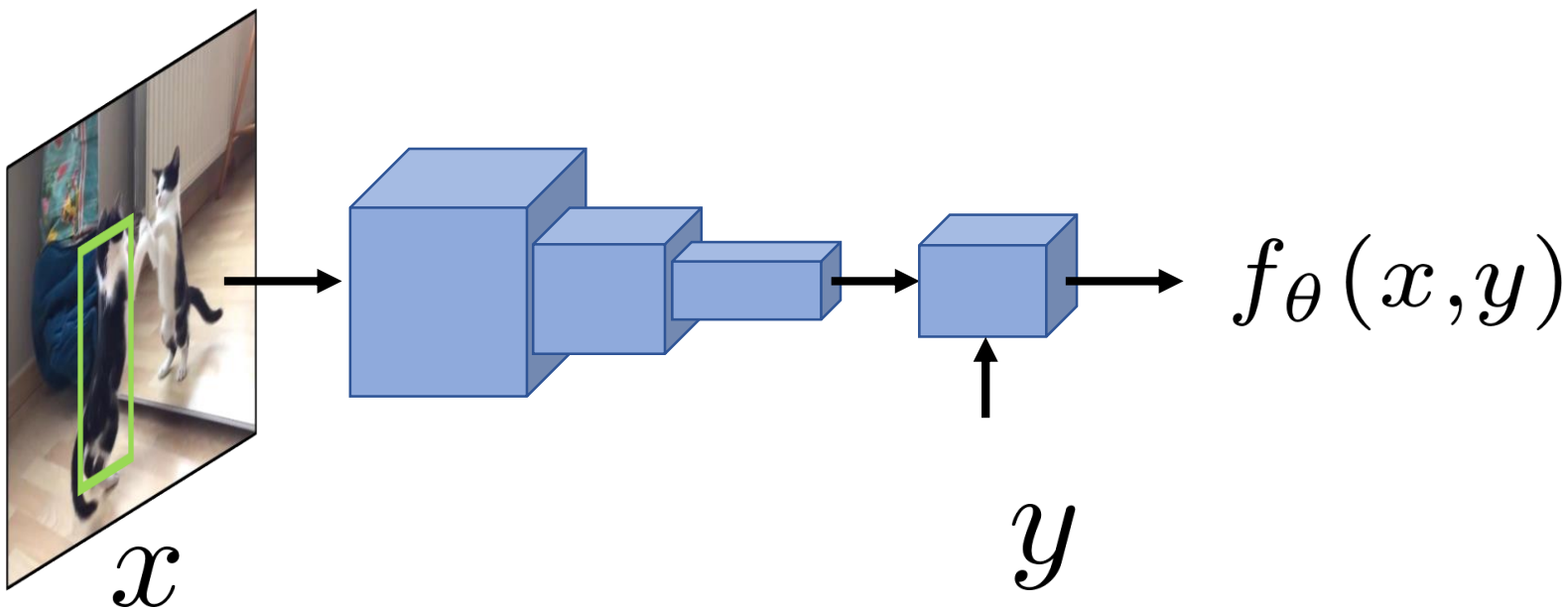
$x$

$y$



# Confidence-Based Regression:

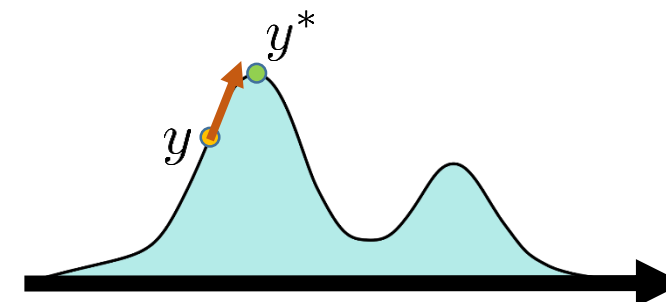
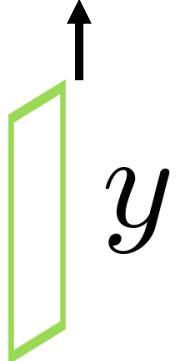
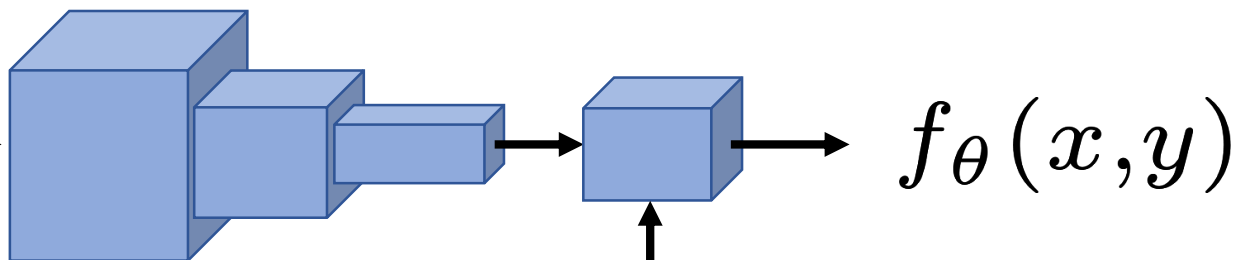
$$y^* = \arg \max_{y \in \mathcal{Y}} f_{\theta}(x, y)$$



# Our Proposed Approach:

We employ **energy-based models** within a probabilistic formulation.

$$y^* = \arg \max_{y \in \mathcal{Y}} p(y|x; \theta) = \arg \max_{y \in \mathcal{Y}} f_{\theta}(x, y)$$



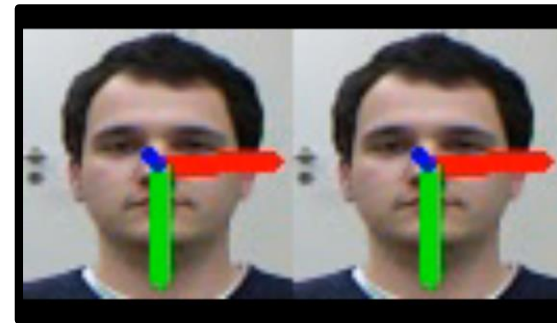
$$p(y|x; \theta) = \frac{e^{f_{\theta}(x, y)}}{\int e^{f_{\theta}(x, \tilde{y})} d\tilde{y}}$$

# Experiments:

We demonstrate state-of-the-art performance on four diverse tasks.



- Object Detection
- **Visual Tracking**
- Age Estimation
- **Head-Pose Estimation**



[github.com/fregu856/ebms\\_regression](https://github.com/fregu856/ebms_regression)

[github.com/visionml/pytracking](https://github.com/visionml/pytracking)