Machine and Deep Learning

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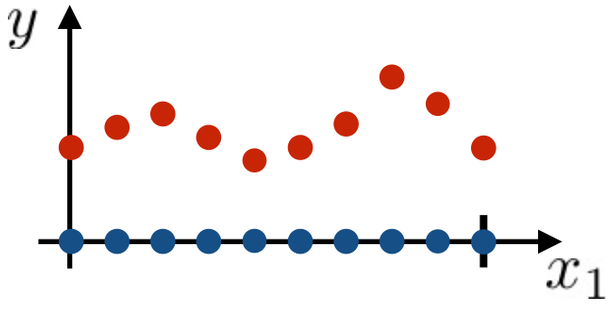
Computer Vision and Machine Learning Engineers (f/m)

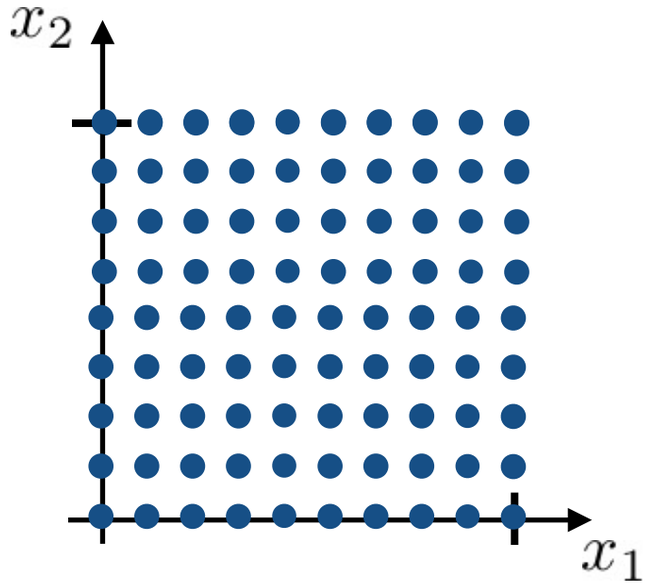
You have

- a M.Sc., or Ph.D. in Computer Science with specialization in Computer Vision (e.g. in segmentation, registration, object detection & tracking, anomaly & event detection) and Machine Learning or equivalent practical experience
- a solid understanding of machine learning and statistics (Random Forests, Deep & Recurrent ANNs, CRFs, SVMs, etc.) and of best practices in feature extraction, dimensionality reduction and model validation
- a strong programming background (Python, C++, R, MATLAB) and familiarity with toolkits such as OpenCV, ITK, Ten- sorflow, Theano, and a working knowledge of software development, deployment methods and cloud stacks. Parallel- ization skills (CUDA, OpenCL, OpenMP, etc) are definitely a plus
- an innovative and decidedly hands-on mindset: you love to work on hard problems and you make solutions work in the real world, too
- the ability to communicate your results, challenges and solution successfully across a multidisciplinary and multicultural team

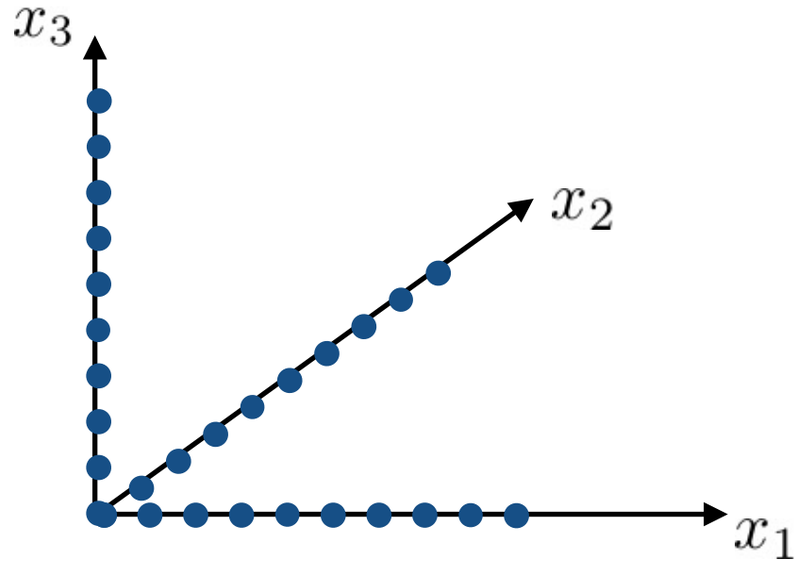
The Curse of Dimensionality



$n = 1: \ 10$



$n = 2: \ 10^2$



$n = 3: \ 10^3$

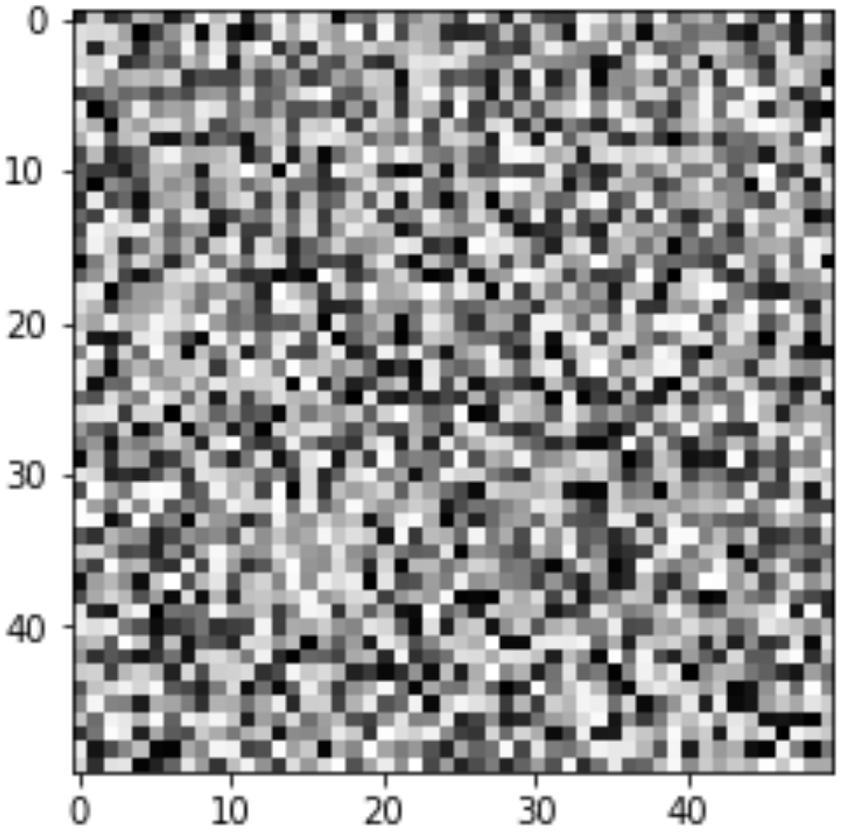
20×50 Image

$n = 1000: \ 10^{1000}$

Number of atoms in the universe : 10^{80}

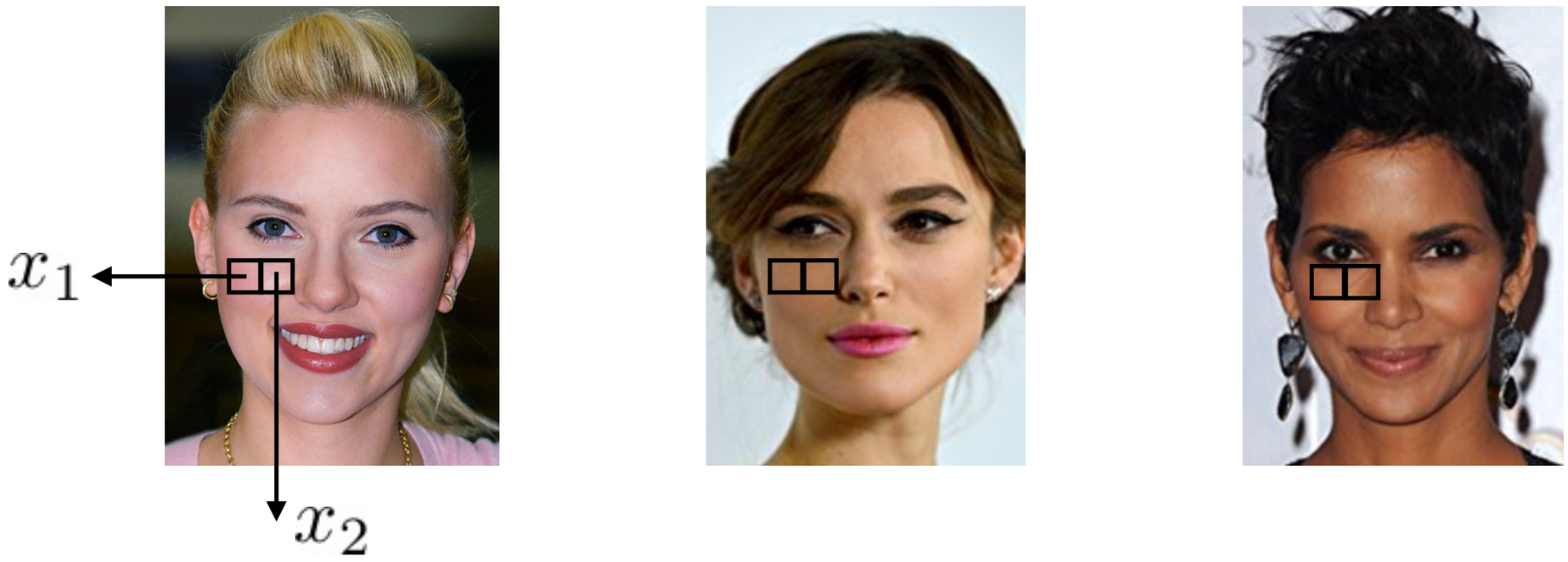
As the number of Features/Dimension grows, the amount of data we need to generalize accurately grows exponentially!

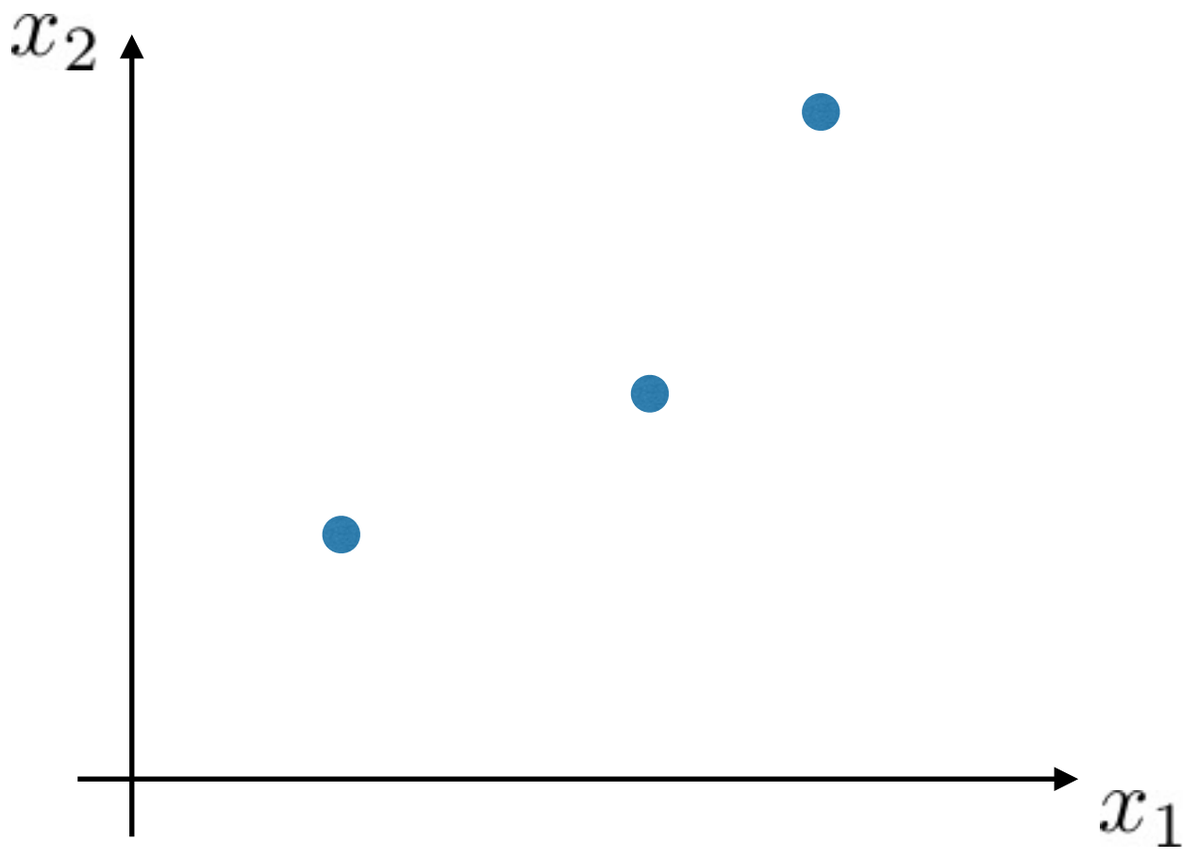
The Curse of Dimensionality



Sampling images uniformly at random (picking each pixel according to a uniform distribution) gives rise to noisy images.

Principal Component Analysis





$$\vec{u}_1^T C \vec{u}_1$$

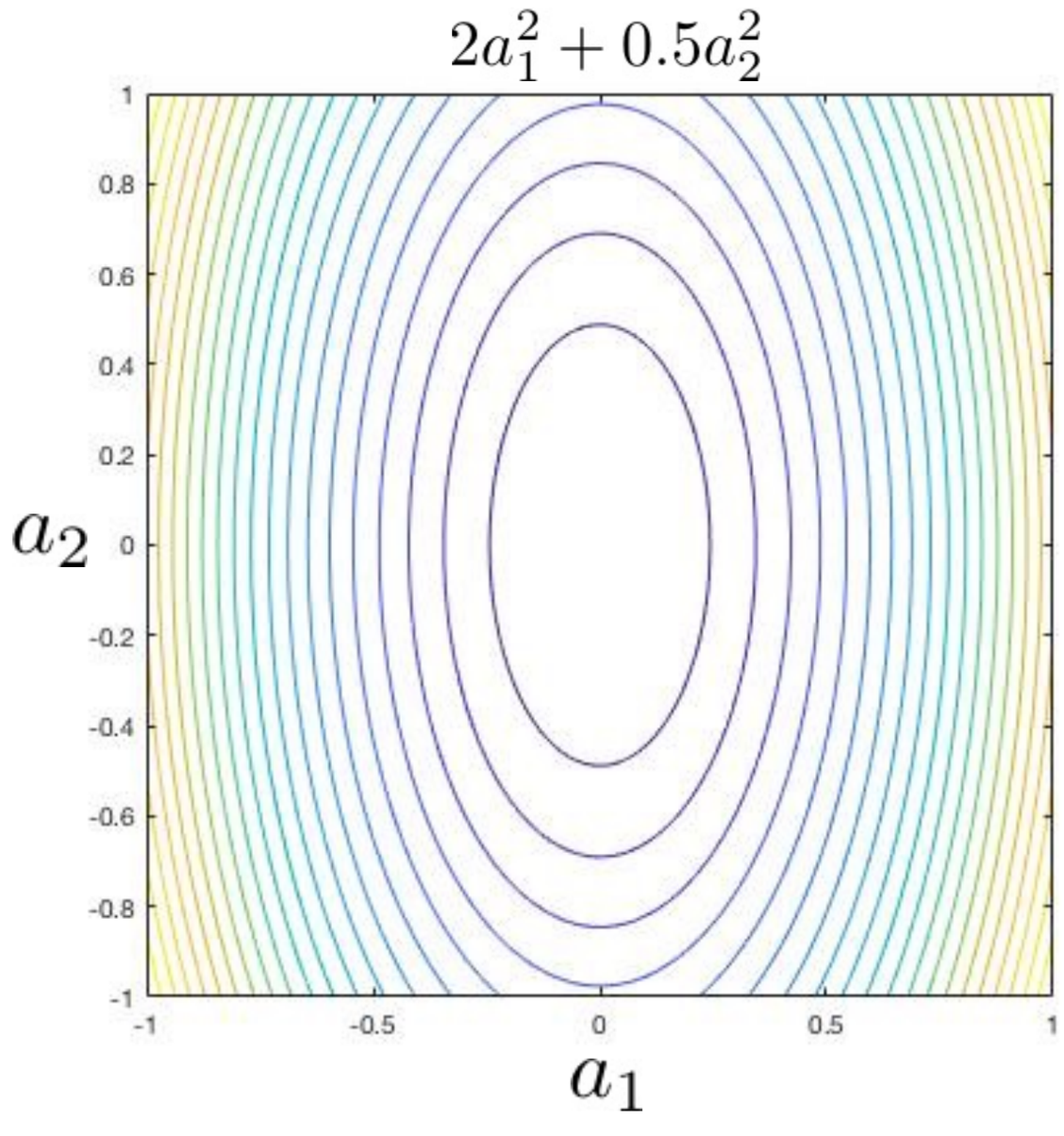
$$\rightarrow \quad \text{Eigenvectors } \vec{c_1}, \vec{c_2} \text{ form ONB}$$

$$\vec{u}_1 = a_1 \vec{c}_1 + a_2 \vec{c}_2 \quad \text{mit} \quad \boxed{a_1^2 + a_2^2 = 1}$$

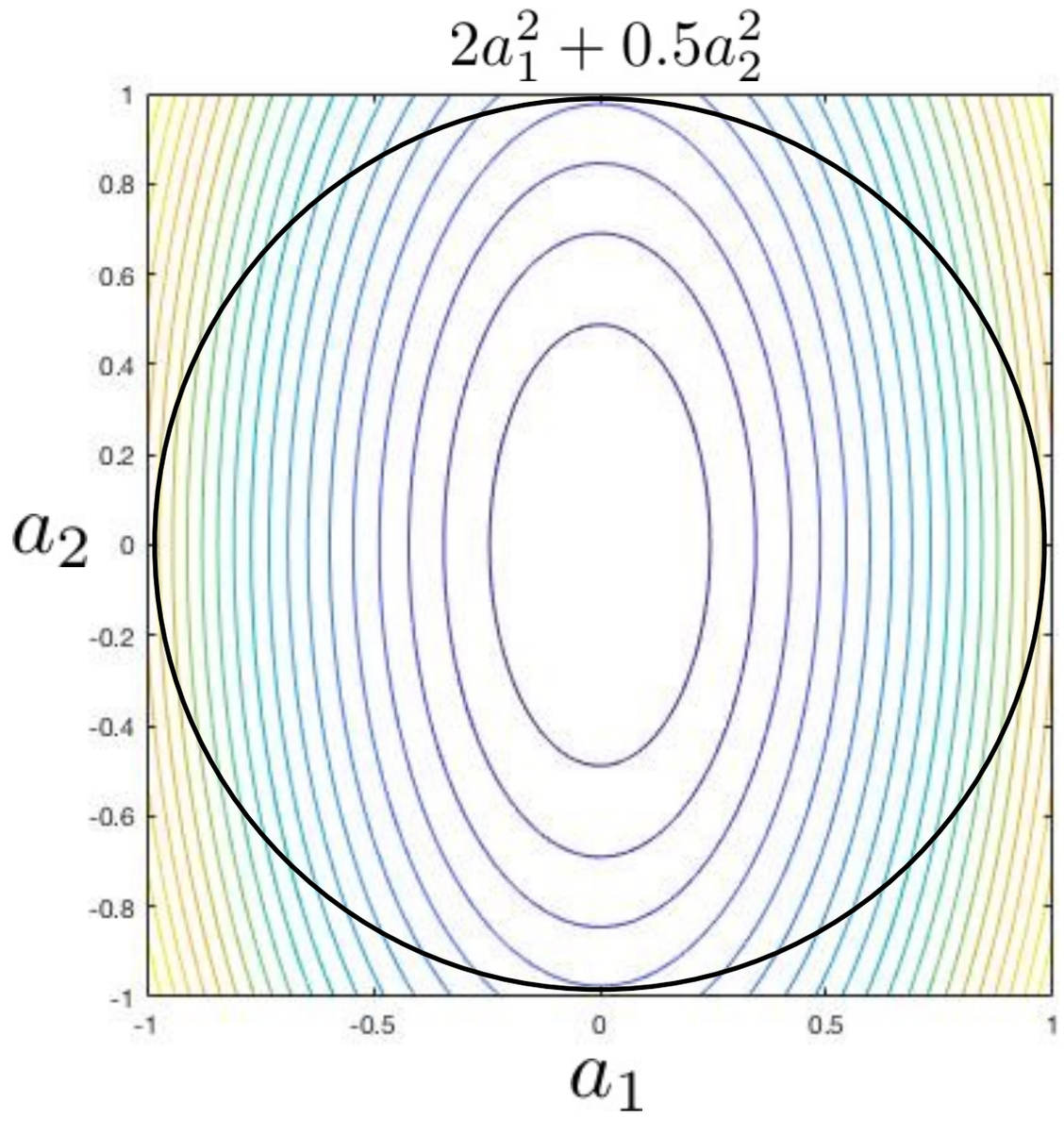
$$\vec{u}_1^T C \vec{u}_1 = \boxed{\lambda_1 a_1^2 + \lambda_2 a_2^2}$$

Principal Component Analysis

$$\lambda_1 a_1^2 + \lambda_2 a_2^2 \quad \rightarrow \quad \max \qquad\qquad a_1^2 + a_2^2 = 1$$

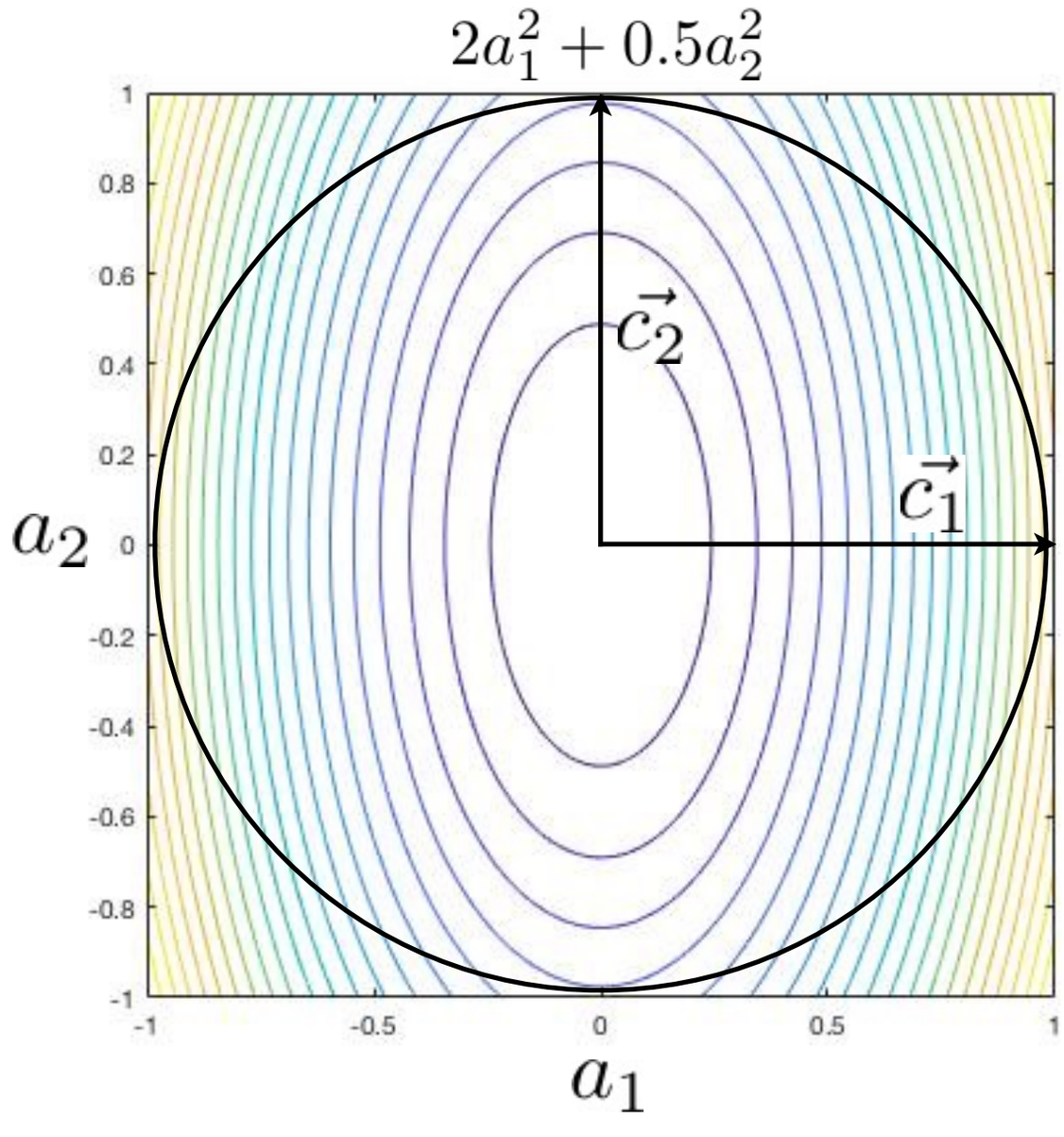


$$\lambda_1 a_1^2 + \lambda_2 a_2^2 \quad \rightarrow \quad \max \qquad\qquad a_1^2 + a_2^2 = 1$$



Principal Component Analysis

$$\lambda_1 a_1^2 + \lambda_2 a_2^2 \quad \rightarrow \quad \max \qquad\qquad a_1^2 + a_2^2 = 1$$



$$\Rightarrow \quad \vec{u}_1 = \vec{c}_1$$

Principal Component Analysis