Computational Aesthetics summary

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Artificial Intelligence & Information Analysis Lab

Computational Aesthetics

- **Neuroaesthetics**
- Computational Aesthetics
- Critical problems in aesthetics
- Connection with Deep Learning
- Paintings – Generative art
- Facial Attractiveness Prediction (FAP)

Neuroaesthetics

- Philosophers and scientists have studied visual aesthetics for a long time.
- From a neuroscience point, the concept of beauty is studied by the field of neuroaesthetics.
- Due to the evolution of machine learning and computer vision particularly, Computational Aesthetics can be considered an AI discipline.

Neuroaesthetics

Aesthetic features have impacted humans' behavior since the dawn of time.

- Neuroaesthetics have been developed recently and try to explain the neural substrates of aesthetic evaluation.

- The goal is to find universal rules in brain units that describe the sense of beauty.

Neuroaesthetics

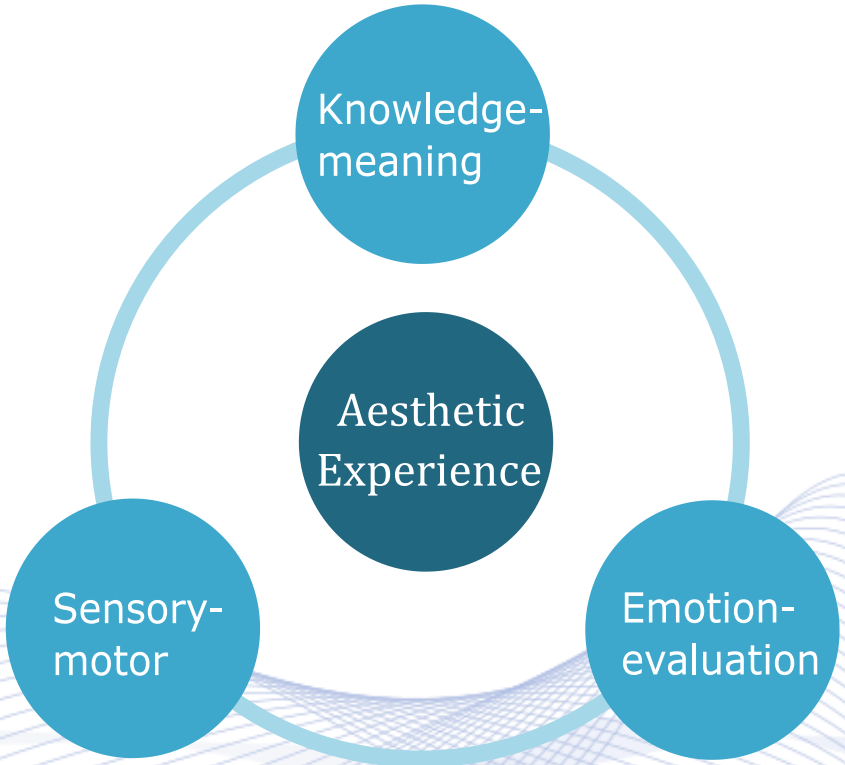

Image representation of the aesthetic triad.

Neuroaesthetics

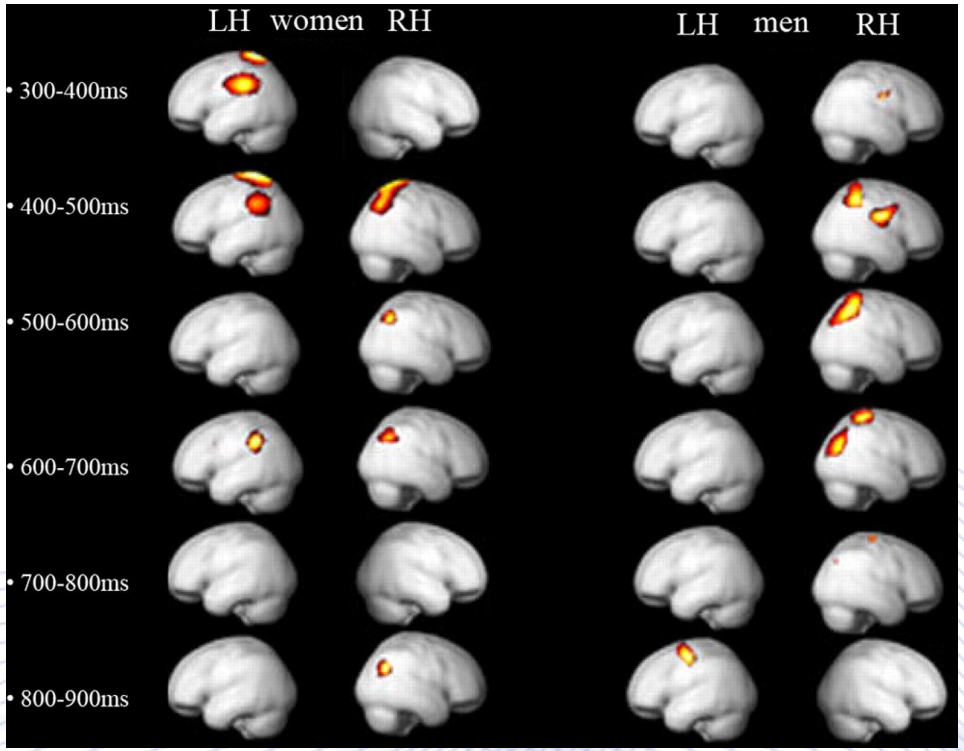

Image representation of the study by Cela-Conde [CEL2009]. Brain areas in which activity is significantly greater ($P < 0.001$) for stimuli rated as beautiful by women and men.

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Computational Aesthetics

- Computational aesthetics presume upon computational methods for explaining aesthetics.
- Computers play a significant role in aesthetic estimation and in inflaming people to understand aesthetics.
- By using different components in pictures, the process of evaluating aesthetics can be automated.

Computational Aesthetics

Birkhoff defines an aesthetic measure M of an art object as the ratio between its order O and complexity C:

$$M = f(\frac{O}{C})$$

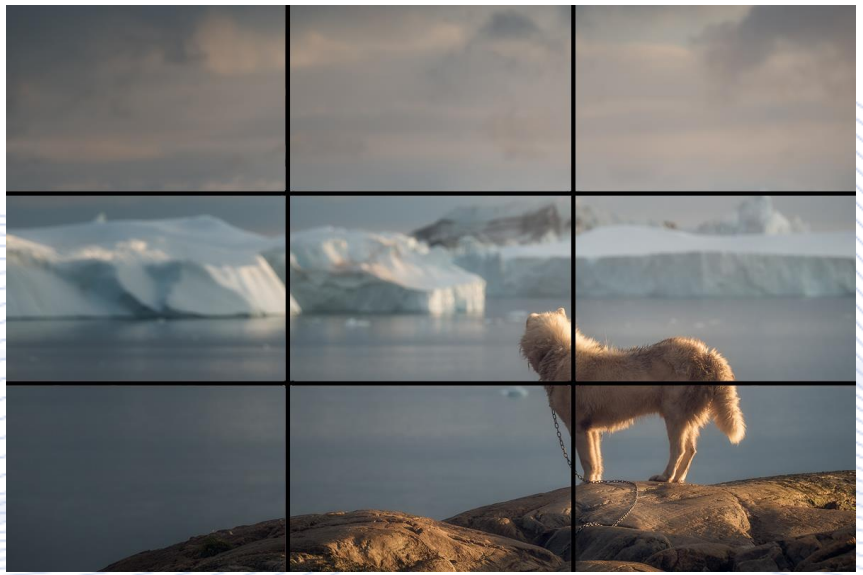
This definition can be justified as:

- Order properties, like object symmetry and rhythm deliver harmonious feelings and trigger the sense of beauty.
- Object complexity can reduce pleasantness, as Gestalt theory postulates that human vision prefers order and predictability.

Computational Aesthetics

Rule of thirds.

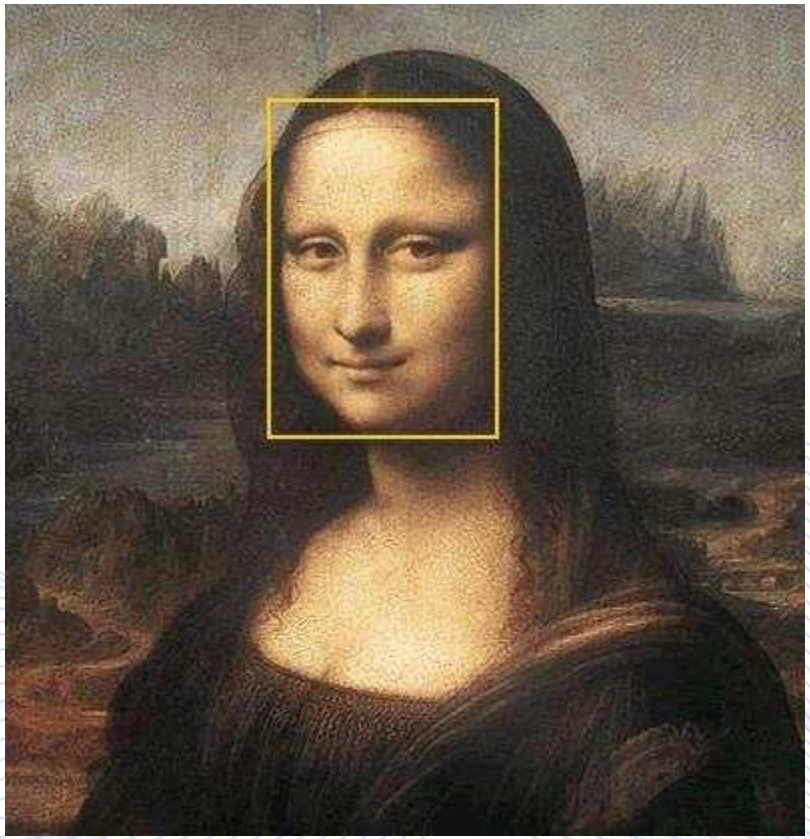
- When the foreground center is at a point satisfying the rule of thirds, the picture becomes more beautiful [TIH2018].



Rule of thirds [CAPTU].

Computational Aesthetics

- Criteria



Mona Lisa golden ratio example [MONA].

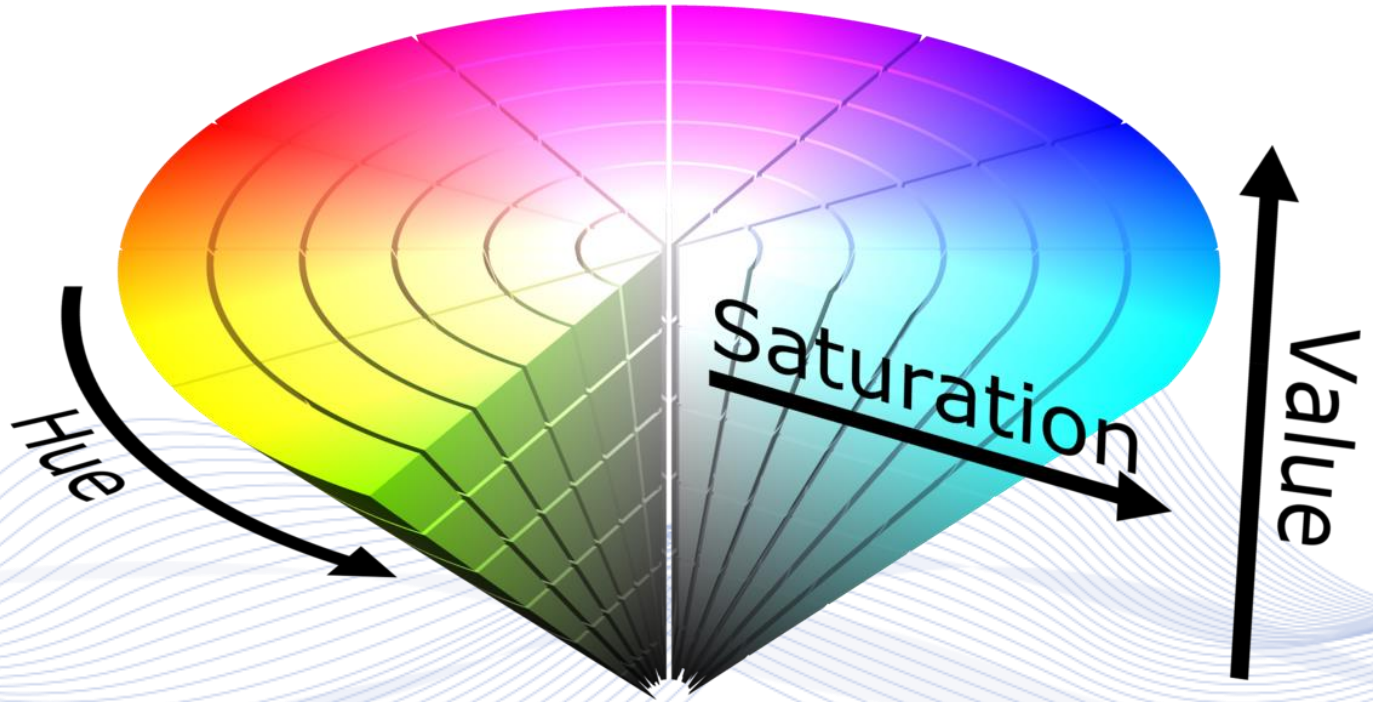
Computational Aesthetics

- Image features

Demonstration of exposure of light/colorfulness feature [DAT2006].

Computational Aesthetics

- Image features



HSV space in the form of a color cone [HSV].

Computational Aesthetics

- Image features

Demonstration of shape convexity feature [DAT2006].

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Critical problems in aesthetics

A plethora of problems have been researched regarding the field of aesthetics. These problems can be divided into:

- Core problems
- Associated problems

Critical problems in aesthetics

- Core problems

Aesthetics Prediction

Assuming an image I is connected with an aesthetic measure $q(I)$, which is the asymptotic average if the entire population rated it. The estimator for the population parameter $q(I)$ over the size n number of ratings is computed by:

$$\hat{q}(I) = \frac{1}{n}\sum_{i=1}^{n} r_i(I)$$

Where $r_i(I)$ is the i^{th} rating given to the image I.

Critical problems in aesthetics

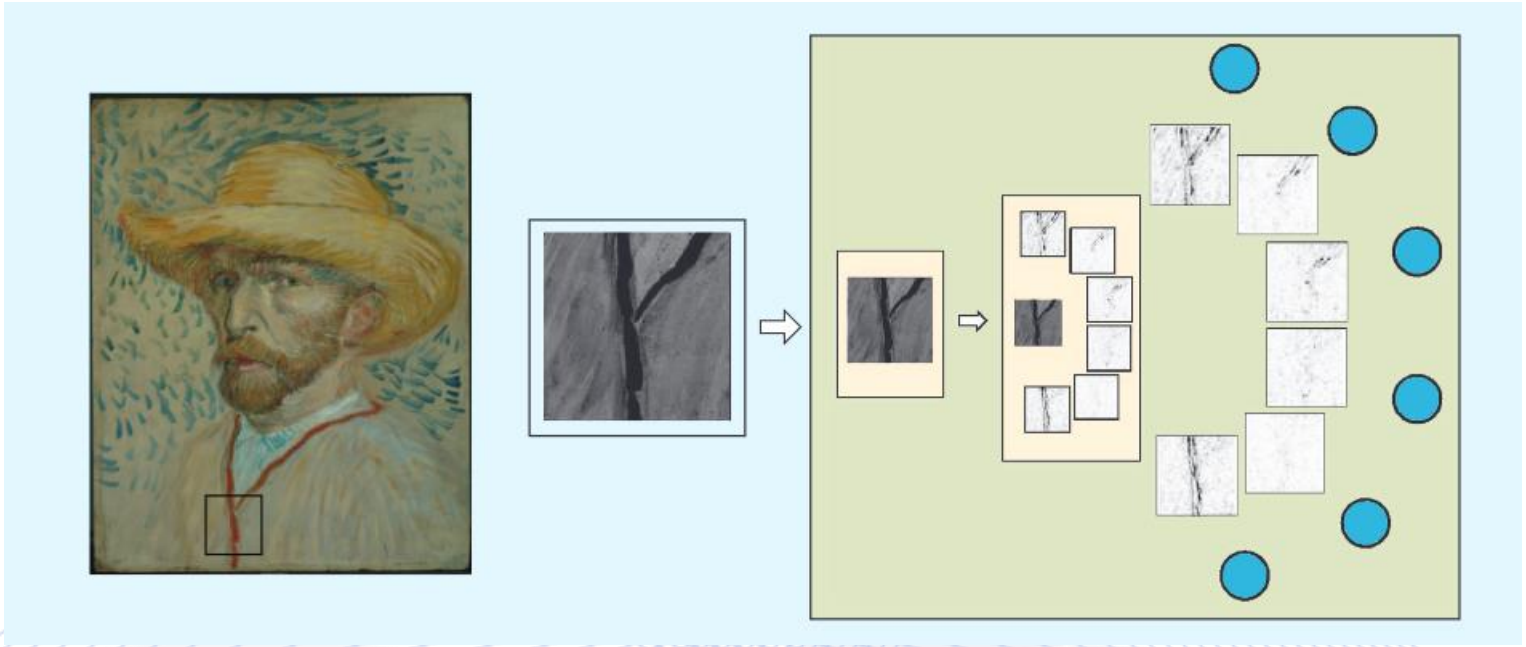
- Core problems

Emotion Prediction

It is possible to group emotions aroused by natural images into categories, so emotion prediction can become a multiclass classification problem.

We assume that K categories of emotions exist, where each person can pick one or more categories for an image.

Critical problems in aesthetics



Dissecting Van Gogh's brushstrokes [JOH2008].

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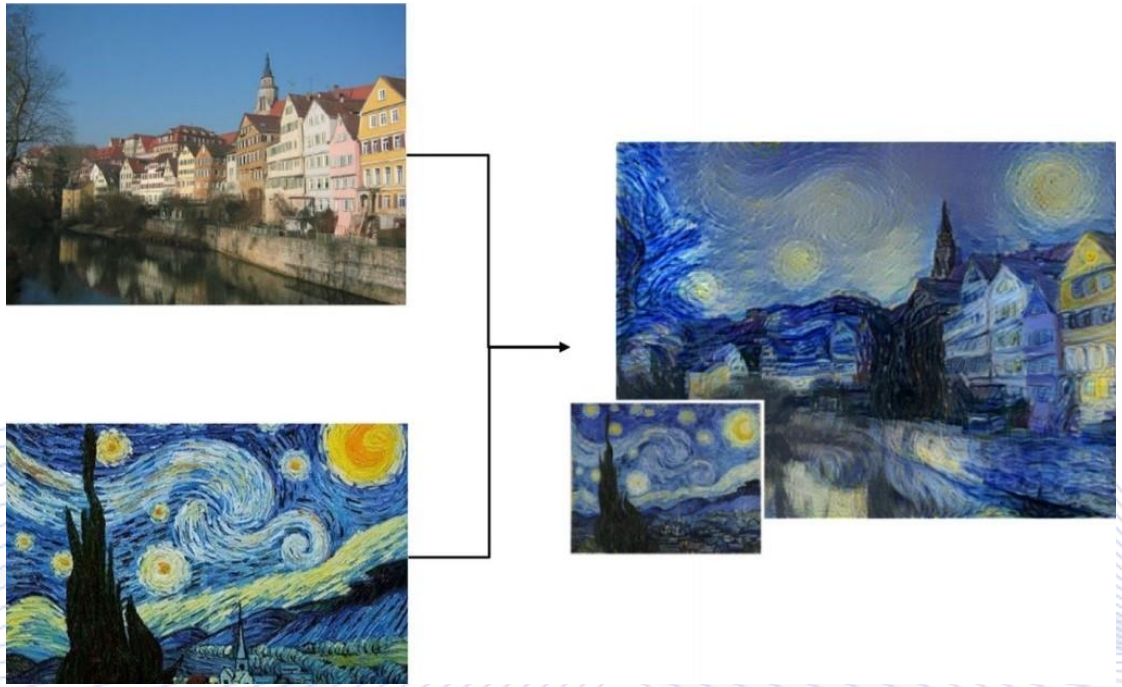
Connection with Deep Learning

- CNN models



Example of image transformation. Up left is content and down left texture.

Connection with Deep Learning

- Regularized double-column convolutional network

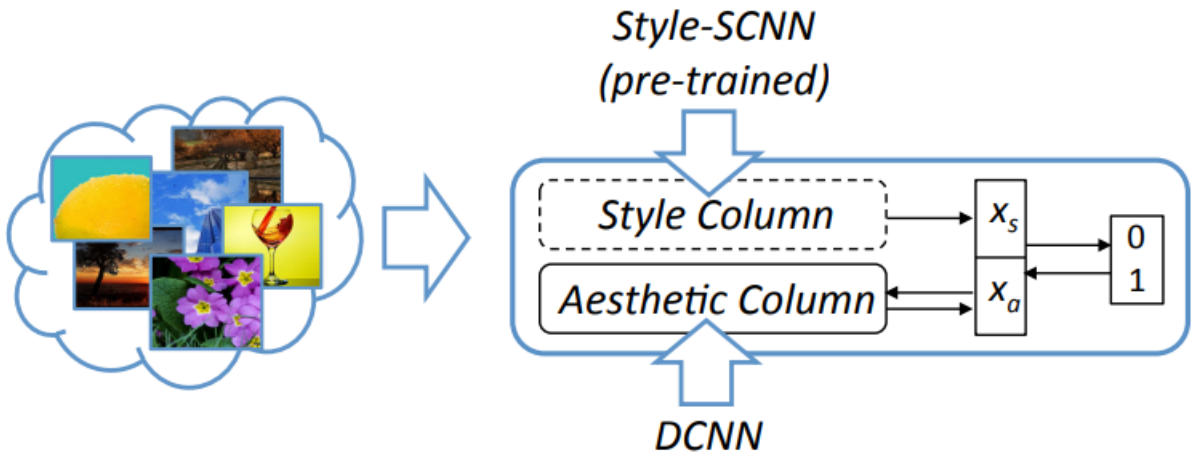


Image representation of a regularized double-column convolutional neural network for aesthetic quality rating [LU2014].

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Paintings – Generative art

- Paintings

- Aesthetic of paintings can be considered as a machine learning problem as well.

- Using features as composition, content, texture, shape, style, originality are used to generate some global and local features.

- Those features can be used by a Naïve Bayes classifier to rate paintings into high and low quality.

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Facial Attractiveness

- Except aesthetics in art and photography, a factor that impacts human life is facial attractiveness.
- Attractiveness of face influences people's social life extensively.
- Despite attractiveness being subjective, humans tend to share a common taste.

Facial Attractiveness

Studies of physical attractiveness try to identify the features that conduce to attractiveness by deliberating the connections among itself and:

- Symmetry
- Averageness
- Hormone markers

Conclusion

- Aesthetics, from art to photography and to human appearance, have been affecting life for centuries.
- Due to technological evolution, they became a computer's object of study and specifically, a deep learning's one.
- Although beauty is in the eye of the beholder, specific rules have been found over the years that can define it.
- Deep learning techniques using neural networks were described above, focusing on face attractiveness prediction.

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Q & A

Thank you very much for your attention!

More material in
http://icarus.csd.auth.gr/cvml-web-lecture-series/

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