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Machine Learning I, II, III
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Digital tapestries with
algorithm-generated plant motifs.
Wool, polyester and silver yarn.

Weaving is an ancient pixel-based image technology and the loom's algorithms (patterns) are binary: thread up/down, on the front/on the back. In the early 1800s, French merchant Joseph Marie Jacquard automated the weaving process with a punched-card system, which fuelled industrialisation and left many textile workers unemployed. Later that century, his punched-card system was used in the design of the world's first punched-card computer, the *Analytical Engine*, which eventually evolved into the modern computer. The loom may thus be considered the precursor to modern computer technology and woven textile the fabric of the digital.

> *We may say most aptly that the Analytical Engine weaves algebraic patterns just as the Jacquard-loom weaves flowers and leaves.*
>
> Ada Lovelace
> *Notes*, 1843

Nineteenth-century industrialisation turned the world on its head – before then, the vast majority of people were farmers, almost everything they needed was produced in the village and it was not necessary to attend school. Today, we are on the threshold of a new revolution brought about by the internet, digitalisation and the development of artificial intelligence in the form of so-called *neural networks* – advanced self-learning algorithms that digitally imitate structures in the human brain and enable machines to make human-like judgements. Just ten years ago, computers could not 'see' what images depicted, instead relying on accompanying text to classify them, and their ability today to recognise faces with relatively great precision can be attributed to the development of neural networks.

Neural networks differ from algorithms of the past in that they are able to rewrite themselves in a process called *machine learning*. This process makes their code extremely long and indecipherable for humans. Hence, as algorithms have become increasingly capable of 'seeing' the world, we humans have paradoxically become increasingly incapable of seeing *into* these algorithms and figuring out how they work.

The floral motifs in *Machine Learning I, II, III* have been developed in collaboration with a neural network called *DeepDream*, which Google made open source in 2015. *DeepDream* is an image recognition algorithm notable for its ability not simply to interpret a given image with words or data, but also to show us pictorially what it 'sees' in the image. Thus, it is an image generating neural network that can offer insight into how the computer 'senses' the world.

'Sees' and 'senses' are written in quotation marks here, because how are we to understand what happens when a computer deciphers an image? Does it constitute a particularly advanced form of a mechanical pattern recognition we are already familiar with? Or is the emergence of computer vision comparable to the biological evolution from light-sensitive cells to image-forming eyes?

Akin to the visual memory of the human brain, the *DeepDream* algorithm operates on the basis of a database of reference images in order to interpret what it 'sees' in a given input image. For the development of the motifs in *Machine Learning I, II, III*, this database consisted of red-listed (endangered) plants growing in the Mesolithic salt marsh of Amager Fælled; a stretch of relatively untouched and un-industrialised land that has been in dispute in recent years as a site for property development.

On the basis of the plant image database, the algorithm has analysed input in the form of black-and-white photographs of OEG students handling their own 2017-technologies, primarily laptops and smartphones, and subsequently shown its interpretation of the pictures in the output. Through this process, the input technology images have largely been overgrown by new, digitally-generated vegetation.

Machine Learning I, II, III is woven from a mixture of wool, polyester and silver yarn on a fully-automated (computerised) Jacquard loom. As artist, I have entered into a digital-organic collaboration with both algorithm and loom – I have fed the algorithm with plant references and input images and sorted the output, taking into account the limited colour space of the loom and the particular texture of the tapestry. Given that the reference images were in colour while the pictures of technology were black-and-white, all colours in the tapestries come from the red-listed plants, which have 'dyed' the yarn in a digital manner.

> *Textile images are never imposed on the surface of the cloth: their patterns are always emergent from an active matrix, implicit in a web which makes them immanent to the processes from which they emerge.*
>
> Sadie Plant
> *Zeros + Ones,* 1997

In *Machine Learning I, II, III*, the Mesolithic salt marsh plants, the industrial loom and the future's neural networks converge in three digital tapestries that draw threads from the past and future, interweaving them with the technologies, stories and materials available just now.

Who forms the fabric that constitutes the present and the future? Plainly, it is those who can *weave* – who can unravel the fabric of the past and present, disentangle the weft from the warp and reweave it into something new. And the weavers' digital sisters: Those who can *program* – who can open up the algorithms, find out what they want from us and reprogram them in new and better ways.

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